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THE FOOTBALL SITUATION.

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I WRITE not as an expert, but rather as an intelligent sympathizer. I have been for twenty-five years an instructor in Yale College, and believe thoroughly in its traditions of work and scholarship. From my youth up having been fond of athletic exercises, and as a student always ready to participate in them, I can write of them understandingly. I have known personally all the captains of the Yale football teams for the past twelve years, most of them intimately. With one exception they have all been my pupils. One of them was a member of my own family. Having exceptional knowledge of the subject, which the possession of these opportunities grants to but few men, I deem it a duty to put in permanent form the results of my observations. I have already done this with reference to the subject of athletics in general.* In this article I wish to confine my attention to the game of football.

I hope to prove that with all its faults it is one of the best forms of athletic sport which can be invented; that by no other game or exercise practiced by young men are the players themselves so much benefited as by football; that the colleges ought to be as much interested in keeping it up as are the most enthusiastic football players themselves; that the public, who have boys to educate, ought to acquaint themselves with the subject. Watching the games when possible, they ought not to allow themselves to be beguiled into condemnation of the sport by sen-

* The Popular Science Monthly, March and February, 1884.

sational writers, who inveigh against it either because they know nothing of it, or because they have determined to know nothing of it, since it does not square with their "historic and traditional idea" of things suitable to a college. Lastly, I wish to suggest lines along which measures for the improvement of the game should be taken, and also to advocate some measures for the better supervision of the sport.

It will surprise many good people, who have been accustomed to hear such an epithet as "brutal" applied to the game of football, that I should claim for it as the first point of superiority over other college athletic sports that it is eminently an intellectual game. A game of football between contestants evenly matched in other respects is won by the superior mental work of the winning team as embodied in the generalship of the captain and the thoughtful work of his men. The game is not simply a struggle for mastery of one body of strong men over another, but it is a contest for supremacy, in which supremacy is gained not by physical strength alone, but by this strength rightly directed by mind.

In the first place, the rules of the game must be observed by every player. He must conform his play to them. He must have them thoroughly in mind, in order to know what he can do, as well as to avoid what he is not permitted to do. These rules are very numerous—more numerous, I believe, than the rules of any other college sport, and cover a wider sphere of action. The interpretation and application of them in every moment of play call for no ordinary quickness of mind in a successful player.

Though each man has a special line of play belonging to his position on a team, yet his play is so related to the plays of the rest of the team that he can not act without regard to the other players. It is eminently a game of combinations. Individual play is important, but team play is more important. The signals of the captain must be heeded by all the players, even if they seem to be given for only two or three men. Through weeks of preparation these signals have to be studied, to be memorized, to be practiced as thoroughly and faithfully by the men as the laws of any science by successful scholars.

The only other college game which is to be compared with it in respect of team play is the game of baseball. Yet in this game the players have fixed positions. Though the men in these positions play in combination with each other, they are remote from one another, and do not at any time join together to make a particular play effective, as the players of a football team move to a common goal. Though team play is important, it is not as important as in football, while individual play, as, for instance, that of pitcher or catcher, is more important. In rowing, the work,

though requiring skill and severe training, is largely mechanical. In track athletics the individual is everything.

That the game has had attractions for intellectual men in the past is shown by the fact that the average scholarship of men on the football teams has of late years been higher than that of men in the other athletic organizations. In the years 1879 to 1888 the average standing of men not on athletic organizations was on a scale of 4, 2·69; for members of the university boat crew the average was 2·52; for members of the baseball nine it was 2·41; for members of the football team it was 2·68. Track athletics were not in existence as an organization through the whole decade, but for the few years when there was a university team the average was 2·66. In the previous decade, 1869 to 1878, it is only fair to add that the average of the football men was slightly below that of the other athletes, it being 2·51 to their 2·56. I can only account for the fact of the rise of the average in the second decade by the change in the numbers of the team from twenty to eleven—a change giving opportunity for more skill, thus rendering the play more attractive to men of mind. Notwithstanding the present style of mass play, which puts a premium on physical strength and weight, it was a surprise to me to find that the average scholarship of the sixteen men from the academic department, including players and substitutes, was higher than the average of any class which ever graduated. I can not believe, however, that the high scholarship of football players will always prevail, unless the style of the game be changed to one which admits of more open play.*

Another advantage of the game is that the practice of it engages a large number of players. A regular team has two more men than the baseball nine, and three more than the crew of eight men. The substitutes, having a systematic training, are more numerous than the substitutes for either baseball or for the crew. Track athletics only can be compared with it in the numbers brought into it. For a short period of the year this latter sport may exercise more men, but taking into consideration the various class teams of football, and especially the team of the freshmen class with substitutes, it is doubtful if even the numbers of those engaging in track athletics exceed the numbers engaging in football.

Of the benefits accruing to the players the physical benefits are the least noteworthy. Yet the play brings into activity almost every muscle of the body. The legs, the arms, and the trunk are all used. No part of the muscular system is developed abnor-

* The style of the game will be changed by the adoption of the new rules, lately recommended by the committee of graduates.

mally. In addition to the opportunity for this uniform development must be mentioned the care bestowed upon the players in the way of attention to injuries received. Not only is the best surgeon employed, but the best professional trainers and rubbers wait on the men to second the efforts of the doctor. To this continual watching of the men on the university teams is due not a little of the comparative immunity from serious injuries received of late years, notwithstanding the rough play in the field.

Another advantage to the players is derived from the great attention given to the diet, not only of the players of the regular team, but of any man who works faithfully as a substitute, or shows any promise of "making the team" at any time in a present or future season. Forty men are at times at the university training table, a number greatly in excess of those at the table of any other organization. The freshman team, too, with their substitutes, have their training table and their attendant coachers, rubbers, and trainers.

But great as are the benefits of the sport to the players in mind and body, they are not to be compared with its moral effects. If there is one virtue most to be desired in a manly character—without which, indeed, it ceases to be manly—that virtue is courage. And of the college sports there is not one which cultivates this manly virtue more than football. Neither is the courage required entirely physical. Indeed, the best players feel and see the danger which they brave. Conscious of injuries received, they often continue to face plays which may exaggerate their pains.

Then the need of self-control in the midst of strong excitement is another valuable lesson learned. Self-denial is taught in the voluntary abnegation of the delights of college, in the forsaking of indulgence in the luxuries of life. To training in courage, endurance, and self-control must be added the valuable lesson of obedience to authority. The discipline in this respect is as strict as the strictest military discipline. Men are required to obey captain and coach and to obey silently. This unquestioning, instant submission to word of command is not the least of the excellent lessons of a football season. It shows its effects in the whole college life and college world.

Strange as it may seem, a good claim can be made of a necessary connection between good character and good football in its best development. In everything requiring the best results the best success depends upon the best men. As there is no other college sport which so brings out the best virtues in a man, so there is no other college sport which is so dependent for its success upon good all-round men. Though this statement is measurably true for all amateur sports, it is emphatically true of football. It has been borne out by facts. The best teams in Yale have had not

only the best players, but the most successful teams have contained the most moral and religious men. In a class prayer-meeting I once heard a man, who was for two years a most valuable player (a captain one of those years), declare that the great success of the team the previous season was, in his opinion, due to the fact that "among the team and substitutes there were so many praying men." As it was with this man, so it has ever been with the successful captains as well as the successful coachers at Yale. They have been God-fearing men, upright in action and clean in speech.

With reference to the colleges, the good effects of the game of football which they produce in common with the other sports need only a passing mention. Among these may be instanced the *esprit de corps* to which they give rise, the healthy excitements necessary to young men which they furnish—excitements which, for many, replace and moderate, if they do not entirely drive out, the old excitements of gambling and drinking, gate-stealing, contests between town and gown, formerly so prevalent and so difficult to deal with on the part of the college authorities. But in addition to these and other benefits to the college world, football with its contests and training comes at a time of the year when it does the most good not only in the directions mentioned, but in two other ways. Boys who are just entering college and, who are for the first time in their careers freed from the restraints of school or home, it introduces to a new discipline, a discipline of their fellows, and to new ideals, which, if not the highest, are at least respectable and worthy of imitation. It brings many of them in contact with the best men in college, and saves not a few of them from wasting their idle hours in foolish and hurtful dissipation. Again, it absorbs the attention of all the college to such a degree as to divert the minds of many of those upper classmen who formerly thought they had a mission to perform in acquainting the new men with the submission required of them in their college home. The discipline of the sport coming at the time it does has almost entirely done away with that occupation. The freshmen have learned their lesson in a better way, under better instructors. The discipline of football has almost banished the discipline of hazing, or left it tame and without excuse for its existence.

To the public the sport is most valuable, especially for those who have boys to educate. The game has spread from the colleges to the schools. The discipline of play has helped the discipline of the study room. Indeed, it has supplemented it with a new education. It has furnished stronger bodies with better brains. It has given an antidote to excessive culture, which often enfeebles the body while it refines the mind. It has given

to the city youths a sport more fascinating with all its dangers and severe restraints than the temptations of city life. What this boon means in its effects upon the coming generations the coming time will show. It certainly is bringing forward a more virile race even in the cities. And the cities in the past have been the first points of decadence of a decaying civilization. As the census reports show, the population is flocking more and more to the cities, so that the growth of athletics began at a time when it was most needed. What President Eliot, in his late report, says of the effect of athletic sports at Harvard, applies with equal truth and force to athletics in all educational institutions—universities as well as schools—"namely, that there has been a decided improvement in the average health and strength of Harvard students during the past twenty-five years. The gain is visible in all sorts of students, among those who devote themselves to study as well as among those who give much time to sports." It was in the colleges that this increased attention to physical exercise was begun, and begun by the students themselves. The system extended to the schools. It has been the parent of most of the athletic clubs now in existence. It furnishes a healthy stimulus and recreation to thousands of young men who but for it would be wasting their strength in much more brutal and brutalizing excitements. It is not too much to say that it is the salvation of our youth. And just as the scholarship of our universities stimulates the intellectual life of these schools, so the athletic contests of the universities keep alive among the schoolboys a healthy admiration for a manly physique. This effect of the college sports has not been sufficiently noticed. It is worth all it costs. It could never have existed if it had not been for the publicity given to the college contests, and to football contests in particular. It has given order to play and introduced obedience to authority and the love of courage into every school in the land. It is not entirely because Yale and Harvard play football or baseball, row and train, that their students show a "decided improvement in their average health during the past twenty-five years," but also because their example has been followed by the schools, and consequently better developed young men are sent from the schools to the universities. The improvement is not confined to college students. It is noticeable in the young men of the whole land. It has produced another effect. The young women of the country have been induced to emulate the physical development of their brothers. They have not played all their rough games, it is true; still, it is undeniable that the greater attention to the physique of women is in some degree an effect of the visible good results of the better development of the men. And all the aids of physical development, such as gymnasiums,

athletic fields, and better playgrounds, have arisen to help on this good work.

As to the disadvantages of football, the sport is like everything else: it is subject to evils. The question is not whether there are evils attending the game, but whether the evils overbalance the good. I admit the evils, but I maintain that the evils have been exaggerated, and that they are not yet great enough to call for the abolition of the game.

Evil No. 1: Excessive time devoted to practice. This charge only applies to the last few weeks of preparation. The first weeks, two hours and a half for most of the players would be the maximum time. For the half-backs three hours would suffice for their maximum time. Part of this time, too, is consumed in going to and from the field or practice ground. Some of the players, more systematic than their fellows, do not consume even so much time. But in the last few weeks, varying in numbers according to the judgment of the captain and coaches of the year, more time is used, amounting, under the most exacting captain, to as many as five hours and a half a day for five weeks. I may add, however, that this exacting captain overdid the business, tired out his team, and suffered the humiliation of a defeat. The most successful captain whom I have known saved the time of his men all through the season, seldom giving them more than two hours' practice, and devoting only one week to hard practice. Five hours a day *is* too much time for a student to devote to any sport. So much time devoted to practice is not necessary for success. On the contrary, it interferes with success, so that this evil is bound to work its own cure. But, even granted that five and a half hours per day for five weeks were given to football practice, it does not follow that those are taken from study, or that, if the game of football were driven out of college, all the players would betake themselves to books. Some of them would give part of their time to study, but poor scholars of the team would still continue to be poor students. Indeed, it is my belief that they would be poorer scholars than before. When they are on the team the very necessity to economize their time compels these men to regular hours of work. When they cease to play football they waste their time. It has always been the result of my observation that though the good scholars of the team do better work in the winter and spring terms, the poor scholars at that time usually fall off in scholarship. But if football is a cause of poor scholarship, why is it that the cause is not uniform in its effects? If it were uniform in its effects all the players would be poor students. Yet the highest honor men are often members of teams. But it may be said that the introduction of football into college has affected the scholarship of the college in general unfavorably, even if it

has not so affected the scholarship of the players themselves. But the facts are against this theory. I took the trouble to go through the scholarship record of two decades—1869 to 1888—decades which witnessed the great development of athletics. For the first decade the average was 2·67 on a scale of 4; for the second decade it was 2·69. In the various sports the average scholarship of the football men was the only one which rose in the second decade higher than in the first, passing from 2·51 to 2·68.

Evil No. 2: Extravagance in expenditure of money earned. Charges of this kind have been made quite recklessly, not only against football but against athletics generally. Knowing that the football teams have earned a great deal of money and not knowing exactly how it is spent, enemies of the game have apparently assumed that it must have been spent extravagantly. None of this money goes to members of the team. It is all paid into the treasury of the Financial Union. The treasurer is a graduate. He pays out money according to the orders of the president of the Y. U. F. B. C., or of the manager of the team. The only persons, then, who could possibly be liable to the charges of wastefulness or extravagance are these three persons. The treasurer can be thrown out of consideration. He is simply an agent, and the writer can testify to the fact that the treasurer exercises a restraining influence. Moreover, as the Financial Union holds and disburses, through this treasurer, the moneys of the other athletic organizations, all the officers of that union (who are also officers of those athletic organizations) exercise a mutual oversight and watchfulness toward one another. This influence is felt for good by the two officers of the university football club as well as by all the others.

Undoubtedly every year much more money is spent than is necessary. Undoubtedly, also, much more money has been spent on football in the last few years than was spent in the first years of the existence of the game, and a judicious economy might have saved a good deal of this money. But it must be remembered that the age is extravagant; that more money is wasted in dress, in furniture, in all the vain show of living than was spent thirty years ago. It must also be borne in mind that in the infancy of the game only the fifteen or eleven members of the team were expected to have their unusual expenses paid out of the football treasury. Now there are a second team of regular substitutes, and many possible candidates for either team, whose extra expenses are defrayed. Again, the students themselves are aware of the danger, and have selected for treasurer a graduate and a business man who will save hundreds of dollars for the organization, besides by his influence in a quiet way acting as a check on any tendency to unnecessary or extravagant expenditures.

Though this officer has been in service only one year, the good results of his work already begin to manifest themselves, as the following figures will show. They are taken from a statement made at my request by the treasurer of the Financial Union. I quote from the letter, only making such changes as will render the statement clear to the general reader:

"I have given the total footings, you will see, of the expenses of the season of 1892 and also of the season of 1893. I have also given you all the items which ran over $1,000 on the expenses account. In comparing the total expenses, the comparison as given on this memorandum is from M——'s report, which was made the 1st of February, and H——'s report, at the same time in the year. It seems to be impossible to get in all the bills, so that the report shall be the same the 1st of February that it is when I hand in my final report of the year in the summer. For the sake of comparison, however, I would say this, that while M——'s report showed $15,284.62 expended when he put in his report, the total expenses of the football season of 1892, when closed up at the end of the college year, showed something over $1,000 more than this, and I should think the season of 1893 would show about the same addition. In either case, you see, it shows a saving in 1893 over the season of 1892, unless there are some outside bills which I, as treasurer, do not know about at present. In addition to that, we carried considerably more men in 1893.

"In the item of the training table, the sum shown on this report does not allow for the sum paid in by each man for his share of the board. As you know, it is the custom for each man to pay what he is paying regularly, so that from these items of the training table there would be a deduction of the amount paid in by the team. As this is not yet in, I have given you the figures as they stand without deducting the same. As nearly as I can calculate it now, Mr. C——, the manager, expects to get between five and six hundred dollars from this source, which would make the training table expenses pretty close down to $2,000. Mr. M——'s collections from the team were not as full as this, so that the saving at the training table will be even more than it appears in this memorandum I am sending you."

	Season 1892.	Season 1893.
Railroad expenses	$1,505 98	$1,303 00
Hotels	3,174 29	2,400 27
'Bus bills	1,004 88	1,026 45
Uniforms and shoes	1,494 50	2,001 49
Training table	2,937 30	2,798 86
Total expenses	$15,284 62	$13,171 95

Before leaving this subject it is only fair to say that there is one form of extravagance of which the football association is not guilty. They do not spend more than their income. They live very far within it. Combining with the baseball association in paying into the Financial Union their earnings, the two organizations more than make up the deficiencies of the others. After paying all bills of all the organizations the Financial Union is able to give $4,000 to the field association, $1,000 to the gymnasium, and still has a reserve fund for future contingencies.

Evil No. 3: Brutality. This is the hardest charge to meet, because there is such a difference of opinion as to what constitutes brutality. In the eyes of timid people any collisions between young men in the most properly conducted game would seem brutal, though these same collisions would be tame fun to the average schoolboy. Personal encounters of some kind seem absolutely necessary to the education of young men, especially young men of the strongest characters. Such young men, judiciously trained, constitute the best citizens of a State. A State full of such citizens becomes thereby the safest to live in, for such men are its best defense. At the dinner given by Colonel Higginson to the teams of Yale and Harvard, it was remarked by Mr. Ropes, the historian, that those nations which practiced semi-military games like football were not only the strongest nations, but that they were the least likely to rush into war; whereas other nations seemed to carry a chip on their shoulders, ready to fight on the smallest provocation. Certainly those who have been intimately acquainted with students and student life for the past twenty-five years can bear testimony not only to the decreasing brutality of college customs, but also to the generally mild and gentlemanly characters of the football players. They, by their influence and example in the college, have largely contributed to this better state of college life.

If violent encounters on the football field do lead to the temptation of inflicting needless personal injuries on an opponent, they also give opportunities for resisting this temptation, and consequently for the development of the highest forms of courage and self-control. According to the observations of the writer, these opportunities are embraced by the majority of the players. Only the minority yield to the temptation, and few of that minority attain to prominent places on a team. If the contrary were the fact, football would long ago have vanished from the list of college sports.

With reference to the evils of public contests—gate money and strains and injuries—the writer sees no reason to change the views already expressed.

"If field athletics are to continue, the expense of them must be

met in one of two ways, either by gate money or by subscriptions. Most young men prefer to give their money at the gate and thus to pay for what they see. If a club knows that it is to spend only what it earns, it will be stimulated, first, to play as good a game as possible; and, secondly, to spend its earnings with prudence. It seems only just, too, that, if the public desire to see a good game, they should pay for the exhibition. The men work hard in practice, and are entitled to have their expenses paid. More than that they do not ask. They do not play for gain but for honor.

"The evil of liability to strains and injuries in athletics can not be entirely obviated. It is well to bear in mind, at this point, the fact that even those who are not athletes do not, therefore, enjoy immunity from accidents. Yet so far, according to the recollection of the writer, no regular member of a Yale crew, team, or nine has been permanently injured by participating in a race or match. Still, it is possible that a slight injury, to a person having organic weakness, might result in a fatal difficulty. Such an issue might be avoided by the requirement that every candidate for trial should be examined by a competent physician, and, in default of procuring a certificate of physical soundness, should be excluded from participation in physical contests." *

As to particular rules looking to the improvement of the game, none but experts should speak.† Yet it might be allowed to those who are interested in it, and who have watched it closely, to make suggestions along the lines in which improvements should be attempted. The present style of mass play and momentum play puts a premium on weight and brute force. The mingling men in masses makes injuries more probable than in an open style of play. The mass play makes the game as little as possible a kicking game. It eliminates a great deal of the element of skill. Skill ought to be encouraged by setting some sort of premium on it. Increasing the number of points scored by a drop-kick from the field might accomplish this somewhat. Some changes in the rules regarding "interference" would do more. If, again, the "warnings" for "rough play" were entirely omitted and the umpire were instructed to send a man off the field at the first offense, captains would train their men to avoid these plays entirely. Then the experts, in reforming the game, could not do better than turn their attention to the umpires. If a plan for training umpires could be devised it would be a good thing. Not every good

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* The Popular Science Monthly, March, 1884.

† Since this article was written the Committee on the Revision of the Rules of Football have met and recommended changes which are substantially in harmony with the suggestions made by the writer in this paragraph.

player, however fair-minded he may be, makes a good umpire. A man without experience as a player, but yet possessing a quick eye, a decisive will, and a knowledge of the rules of the game, might be a better umpire than the most famous player.

As to interference by the faculties in the way of measures limiting the game, I have already hinted at one, namely, the requiring a certificate of physical soundness for every candidate for athletic honors. I would also limit teams to undergraduates. This measure would bring the teams better under the control of faculty supervision, and would besides put a certain limit to competition. In the first place, the professional schools do not exercise a strict personal supervision over the students. They assume, and rightly, that a man who commences the study of a profession has begun the serious business of life, and is capable of directing his own time. He may be absent from every exercise of the school except the examinations. Passing those, he can still be a member of the school in good and regular standing. Such a student, when in competition for a place on the team with a member of the undergraduate department, who is held up to attendance on daily exercises, has a great advantage over him. His freedom from restraint exercises a pernicious influence on the man who is subject to restraint. Concert of action between the faculties of undergraduate departments and those of graduate and professional schools in the way of control of any sport is almost impossible from the very circumstances of the case.

Instead of appointing committees to act with the students in the regulation of the sports, a better way to control them would be the appointment of a director of athletics to a seat in the undergraduate faculty, who should be the medium of communication between the students and the instructors. Such a man ought to have the confidence of the students and be in sympathy with them. He ought also to be a gentleman and a scholar, a graduate of the college, and a man holding its best traditions of righteousness and scholarship sacred. Such a man would be alive to the responsibilities of both sides—of the scholarship side as represented by the instructors, and of the healthy boy side of student life. I would not have the mangement of athletics taken by him out of the hands of the students, but I would have him help them with advice and with instruction, too, if necessary. I would have him attend the practice games and the races, oversee the coaches and trainers, and watch the players and students. He could prevent, without recourse to "reporting to the faculty," repetitions of mistakes and follies on the part of the students. He could keep out bad men from the list of trainers. He could prevent many a promising lad from wrecking himself by making the excitement of college sport the be-all and end-all of his existence. By his

presence among the instructors he could, as opportunity offered, with timely words, fend off those sad mistakes which worthy gentlemen of the best intentions sometimes make in their dealings with boys—mistakes of which I think I am justified in saying that Yale has not often been guilty in the past fifteen years. The director would earn his salary if he did faithfully what his hand found to do.

If such men were appointed by all the colleges, and if joint action by the colleges at any time seemed desirable, these men would be best fitted to deal with questions which might arise, and would discover solutions of existing difficulties without recommending unpractical and impossible plans.

STUDIES OF CHILDHOOD.

III.—THE QUESTIONING AGE.

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THE child's first vigorous effort to understand the things about him may be roughly dated at the end of the third year, and it is noteworthy that this synchronizes with the advent of the questioning age. The first putting of a question occurred in the case of Preyer's boy in the twenty-eighth month, in that of Pollock's girl in the twenty-third month. But the true age of inquisitiveness, when question after question is fired off with wondrous rapidity and pertinacity, seems to be ushered in with the fourth year.

A common theory peculiarly favored by ignorant nurses and mothers is that children's questioning is a studied annoyance. The child has come to the use of words, and with all a child's "cussedness" proceeds to torment the ears of those about him. There are signs, however, of a change of view on this point. The fact that the questioning follows on the heels of the reasoning impulse might tell us that it is connected with the throes which the young understanding has to endure in its first collision with a tough and baffling world. The question is the outcome of ignorance coupled with a belief in a possible knowledge. It aims at filling up a gap in the child's knowledge, at getting from the fuller knowledge of another some light on the scrappy, unsatisfying information about things which is all that his own observation can gather, or all that others' half-understood words have managed to communicate. It is the outcome of intellectual craving—a demand for food. But it is much more than an expression

of need. Just as the child's articulate demand for food implies that he knows what food is, and that it is obtainable, so the question implies that the little questioner knows what he needs, and in what direction to look for it. The simplest form of question—e. g., What is this flower, this insect?—shows that the child, by a half-conscious process of reflection and reasoning, has found his way to the truth that things have their qualities, their belongings, their names.

Questioning may take various directions. A good deal of the child's catechising of his long-suffering mother is prompted by thirst for fact.* The typical form of this line of questioning is "What?" The motive here is to gain possession of some fact which will connect itself with and supplement a fact already known. How old is Rover? Where was Rover born? Who was his father? What is that dog's name? What sort of hair had you when you were a little girl? These are samples of the questioning activity by the help of which the little inquirer tries to make up his connected wholes—to see things with his imagination in their proper attachment and order. And how greedily and pertinaciously the small people will follow up their questioning, flying, as it often looks, wildly enough from point to point, yet gathering from every answer some new contribution to their ideas of things! A boy of three years and nine months would thus attack his mother: "What does frogs eat, and mice, and birds, and butterflies? and what does they do? and what is their names? What is all their houses' names? What does they call their streets and places?" etc.

Such questions easily appear foolish because, as in the case just quoted, they are directed by quaint childish fancies. The child's anthropomorphic way of looking out on the world leads him to assimilate animal to human ways. Hence one value of these questionings as showing which way the current of the child's thought is setting. Hence, too, it would appear that not every child's question is to be answered. We may, however, set aside, or rather correct, the form of a child's question without treating it with an ill-deserved and quite inappropriate contempt.

One feature in this fact-gleaning kind of question is the great store which the child sets by the name of a thing. M. Compayré has pointed out that the form of question, "What is this?" often means "What is it called?" The child's unformulated theory seems to be that everything has its own individual name. The little boy just spoken of explained to his mother that he thought all the frogs, the mice, the birds, and the butterflies had names

* The first question put by Preyer's boy was, "Where is mamma?" That is an inquiry as to fact.

given to them by their mothers, as he himself had. Perhaps this was only a way of expressing the childish idea that everything has its name, primordial and unchangeable. A nameless thing may well seem to a child no less of a contradiction than a thing without any size. Perhaps, too, the name as an external sound joins itself to and qualifies the thing in a way that we, who are wont to employ words as our own created signs, can hardly enter into.

A second direction of this early questioning is toward the reason and the cause of things. The typical form is "why?" This form of inquiry occurred in the case of Preyer's boy at the age of two years and forty-three weeks. But it becomes the all-predominant form of question somewhat later. Who that has tried to instruct the small child of three or four does not know the long, shrill, whinelike sound of this question? This form of question develops naturally out of the earlier, for to give the "what" of a thing—that is, its connections—is to give its "why" —that is, its mode of production, its use and purpose.

Nothing, perhaps, in child utterance is better worth interpreting, hardly anything more difficult to interpret, than this simple-looking little "why?"

We ourselves, perhaps, do not use the word "why" and its correlative "because" with one clear meaning; and the child's first use of the words is largely imitative. What may be pretty safely asserted is that even in the most parrotlike and wearisome iteration of "why" and its equivalents "what for?" etc., the child shows a dim recognition of the truth that a thing is understandable, that it has its reasons if only they can be found.

Let us, in judging of this pitiless "why?" try to understand the situation of the young mind confronted by so much that is strange and unassimilated, meeting by observation and hearsay with new and odd occurrences every day. The strange things standing apart from his tiny familiar world, the wide region of the quaint and puzzling in animal ways, for example, stimulate the instinct to appropriate, to master. The little thinker must try at least to bring the new and the odd into some recognizable relation to this familiar world. And what is more natural than to go to the wise lips of the grown-up person for a solution of the difficulty? The fundamental significance of the "why?" in the child's vocabulary, then, is the necessity of connecting new with old, of illuminating what is strange and dark by light reflected from what is already matter of knowledge. And a child's "why?" is often temporarily satisfied by supplying from the region of the familiar an analogue to the new and unclassed fact. Thus his impulse to understand why pussy has fur is fully met by telling him that it is pussy's hair.

It is only a step further in the same direction when the "why" has to be met by supplying a general statement: for to refer the particular to a general rule is a more perfect and systematic kind of assimilation. Now we know that children are very susceptible to the authority of precedent, custom, general rule. Just as in children's ethics customary permission makes a thing right, so in their logic the fact that a thing generally happens may be said to supply a reason for any single thing happening. Accordingly, when the much-abused nurse answers the child's question, "Why is the pavement hard?" by saying, "Because pavement is always hard," she is perhaps less open to the charge of giving a woman's reason than is sometimes said.* In sooth, the child's queries, his searchings for explanation are, as already suggested, prompted by the desire for order and connectedness. And this means that he wants the general rule to which he can assimilate the particular and as yet isolated fact.

From the first, however, the "why" and its congeners have reference to the causal idea, to something which has brought the new and strange thing into existence and made it what it is. In truth, this reference to origin, to bringing about or making, is exceedingly prominent in children's questionings. Nothing is more interesting to a child than the production of things. What hours and hours does he not spend in wondering how the pebbles, the stones, the birds, the babies are made! This vivid interest in production is to a considerable extent practical. It is one of the great joys of children to be able themselves to make things, and the desire to fashion things which is probably at first quite immense, and befitting rather a god than a feeble child, naturally leads on to know something about the mode of producing. Yet from the earliest a true speculative interest blends with this practical instinct. Children are in the complete sense little philosophers, if philosophy, as the ancients said, consists in knowing the cause of things—"*causas rerum cognoscere.*" This is the completed process of assimilation, of the reference of the particular to a general rule or law. Everything remains a mystery, looks distant and foreign, until its history, its origin is ascertained, and it can be classed with the known things whose existence is accounted for.

This inquisition into origin and mode of production starts with the amiable presupposition that all things have been hand-produced after the manner of household possessions. The world is a sort of big house where everything has been made by somebody, or at least fetched from somewhere. This application of the anthropomorphic idea of fashioning follows the law of all

* Cf. some shrewd remarks by Dr. Venn, Empirical Logic, p. 494.

childish thought that the unknown is assimilated to the known. The one mode of origin which the embryo thinker is really and directly familiar with is the making of things. He himself makes a respectable number of things, including these rents in his clothes, messes on the table cloth, and the like, which he gets firmly imprinted on his memory by the authorities. And, then, he takes a keen interest in watching the making of things by others, such as puddings, clothes, houses, hayricks. To ask who made the animals, the babies, the wind, the clouds, and so forth, then, is for him merely to apply the more familiar type of causation as norm or rule. Similarly in all questions as to the "whence" of things, as in asking whether babies were bought in a shop.

The "why" takes on a more special meaning when the idea of purpose and adaptation of means to ends becomes clear. The search now is for the end, what philosophers call the teleological cause or reason. Here, again, the child sets out with the familiar type of experience, with human production and action as determined by aim. And it is easy for him, his mind being possessed by this anthropomorphic fancy which gives life to all things, to carry out this kind of inquiry. There is a stage in the development of a child's intelligence when questions such as "Why do the leaves fall?" "Why does the thunder make such a noise?" are answered most satisfactorily by a poetic fiction—by saying, for example, that the leaves are old and tired of hanging on to trees, and that the thunder-giant is in a particularly bad temper, and making a row. It is perhaps permissible to make use of this fiction at times, more especially perhaps when trying to answer the untiring questioning about animals and their doings—a region of existence, by the way, of which even the wisest of us knows exceedingly little. Yet the device has its risks; and an ill-considered piece of myth-making passed off as an answer may find itself awkwardly confronted by that most merciless of things, a child's logic.

But there is another sort of anthropomorphism in this interrogation. Children are apt to think not only that things in general are after our manner, but, what is very different, have their designs, so to speak, upon us. The sea, it will be remembered, made its noise with special reference to the ears of the small child C——. We may call this the anthropocentric idea—that is, the idea that man is the center of reference in the case of natural phenomena. This anthropocentric tendency is apt to get toned down by the temperament of a child, which is on the whole optimistic and decidedly practical, into a looking out for the *uses* of things. A boy, already quoted, once (toward the end of the fourth year) asked his mother what the bees do. This question he explained by adding "What is the good of them?" When told that they

made honey, he observed pertinently enough from his teleological standpoint, "Then do they bring it for us to eat?"

The idea underlying this questioning as to uses is the same idea which the theological optimists of the last century were wont to drive to such a surprising length. Their amusing speculations showed how far from easy it is to apply the idea to particular cases, and our small philosopher evidently saw the difficulty in the case of the bees, not by any means one of the most difficult.

A child's question may be prompted merely by ignorance and curiosity, or by a deeper motive, a sense of perplexity, of mystery, or contradiction. It is not always easy to distinguish the two types of question, yet in many cases at least its form, and the manner of putting, it will tell us that it issues from a puzzled and temporarily baffled brain. As long as the questioning goes on briskly, we may infer that a child believes in the possibility of knowledge, and does not know the deepest depths of intellectual despair. More pathetic than the saddest of questions is the silencing of questions by the loss of faith.

It is easy to see that children must find themselves puzzled with much which they see and hear of. The apparent exceptions to the rule don't trouble the grown-up persons, just because as *recurrent* exceptions they seem to take on a rule of their own. Thus adults, though quite unversed in hydrostatics, would be incapable of being puzzled by C——'s problem, why my putting my hand in water does not make a hole in it. Similarly, though they know nothing of animal physiology, they are never troubled by the mystery of fish breathing under water, which when first noted by a child may come as a sort of shock. The little boy just referred to, in his far-reaching zoölogical interogatory asked his mother, "Can they (the fish) breathe with their moufs under water?"

In his own investigations, and in getting instruction from others, the child is frequently coming upon puzzles of this sort. The same boy was much exercised about the sea and where it went to. He expressed a wish to take off his shoes and to walk out into the sea so as to see where the ships go to, and was much troubled on learning that the sea got deeper and deeper and that if he walked out into it he would be drowned. At first he denied the paradox (which he at once saw) of the incoming sea going uphill. "But, mamma, it doesn't run up, it doesn't run up, so it couldn't come up over our heads?" He was told that this was so, and he wisely began to try to accommodate his mind to this startling revelation. C——, too, was much exercised by this problem of the moving mass of waters, wanting to know whether it came half-way up the world. Probably in both these cases the idea of water rising had its uncanny, alarming aspect.

We have seen that the disappearance of a thing is at a very

early stage a puzzle to the infant. Later on, too, the young mind continues to be exercised about this mystery. Our little friend's inquiry about the whither of the big, receding sea, "Where does the sea sim (swim) to?" illustrates this perplexity. A child seems able to understand the shifting of an object of moderate size from one part of space to another, but his conception of space is probably not large enough to permit him to realize how a big tract of water can pass out of the visible scene into the unseen. The child's question, "Where does all the wind go to?" seems to have sprung from a like inability to picture a vast unseen realm of space. C——'s question as to where all the days go to may have been prompted by the idea that the days or their scenic contents continue to exist somewhere; that the past is something like the unseen region of space into which things disappear as they move away from us.

In addition to this difficulty of the disappearance of big things, there seems to be something in the vastness, the infinite quantity and number of existents perceived and heard about, which puzzles and oppresses the young mind. The inability to take in all the new facts leads to a kind of resentment at their multitude. "Mother," asked a boy of four years, "why *is* there such a lot of things in the world if no one knows all these things?" One can not be quite sure of the underlying thought here. Did the child mean merely to protest against the production of so confusing a number of objects, or was there a deeper difficulty, a dim presentiment of Berkeley's idealism, that things can exist only as objects of knowledge? This surmise may seem far-fetched to some, yet I have found what seem to me other traces of this tendency in children. A girl of six and a half years was talking to her father about the making of the world. He pointed out to her the difficulty of creating things out of nothing, showing her that when we made things we simply fashioned materials anew. She pondered and then said, "Perhaps the world's a fancy." Here, again, one can not be quite sure of the child-thought behind the words. Yet it certainly looks like a falling back for a moment into the dreamy mood of the idealist—that mood in which we seem to see the solid fabric of things dissolve into a shadowy phantasmagoria.

The subject of origins is, as we know, beset with puzzles for the childish mind. The beginnings of living things are of course the great mystery. "There's such a lot of things," remarked the little zoölogist I have recently been quoting, "I want to know, that you say nobody knows, mamma. I want to know who made God, and I want to know if pussy has eggs to help her make ickle (little) kitties." Finding that this was not so, he observed, "Oh, then, I s'pose she has to have God to help her if she doesn't have kitties in eggs given her to sit on." Another little boy, five years

old, found his way to the puzzle of the reciprocal genetic relation of the hen and the egg, and asked his mother: "When there *is* no egg, where does the hen come from? When there *was* no egg, I mean, where *did* the hen come from?" In a similar way as we saw in C——'s journal a child will puzzle his brains by asking how the first child was suckled, how the first chicken-pox was acquired, how the first man learned to speak (without any example).

The allied mystery of growth is also a frequent theme of this early questioning. "How" (asked one little three-year-old questioner) "does plants grow when we plant them? and how does boys grow from babies to big boys like me? Has I grown now while I was eating my supper? See!" and he stood up, to make the most of his stature. It would be funny to know all a child's speculations on this supremely interesting matter of growth. But of this more by and by.

Much of this questioning is metaphysical, in that it transcends the problems of every-day life and of science. The child is metaphysician in the sense in which the earliest human thinkers were metaphysicians, pushing his questioning into the inmost nature of things, and back to their absolute beginnings. He has no idea yet of the confines of human knowledge. If his mother tells him she does not know, he tenaciously clings to the idea that somebody knows—the doctor it may be, or the clergyman, or possibly the policeman, of whose superior knowledge one little girl was forcibly convinced by noting that her father once asked information of one of these willing officials.

Strange, bizarre, altogether puzzling to the listener are some of the child's questions. The "why" is applied to everything in a most bewildering fashion. A little American girl, of nine years, after a pause in talk, recommenced the conversation by asking, "Why don't I think of something to say?" A play recently performed in a London theater made precisely this line of questioning a chief amusing feature in one of its comical characters. Another little American girl, aged three, one day left her play and her baby sister, named Edna Belle, to find her mother and ask, "Mamma, why isn't Edna Belle me, and why ain't I Edna Belle?"* The narrator of this story adds that the child was not a daughter of a professor of metaphysics but of practical farmer folk. One can not be quite sure of the precise drift of this question. It may well have been the outcome of a new development of self-consciousness, of a clearer awareness of the self in its distinctness from others. A question with a much clearer metaphysical ring about it, showing thought about the subtlest prob-

* Quoted from an article, Some Comments on Babies, by Miss Shinn, in the Overland Monthly, January, 1894.

lems, was that put by a boy of the same age: "If I'd gone upstairs, could God make it that I hadn't?"

All children's questioning does not, of course, take this sublime direction. Along with the tendency to push back inquiry to the unreachable beginning of things we mark a more modest and scientific line of investigation into the observable and explainable processes of Nature. Some questions which a busy listener would pooh-pooh as dreamy have a genuinely scientific value. showing that the little inquirer is trying to work out some problem of fact. This is illustrated by a question put by a little boy aged three years and nine months. "Why don't we see two things with our two eyes?"—a problem which, as we know, has exercised older psychologists.

When this more definitely scientific direction is taken by a child's questioning we may observe that the ambitious "Why?" begins to play a second rôle, the first being now taken by the more modest "How?" The boy Clerk Maxwell, with his incessant inquiries into the "go" of this thing or the "particular go" of that, illustrates this early tendency to direct questioning to the more manageable problems to which science confines itself.

These different lines of questioning are apt to run on concurrently from the end of the third year, a fit of eager curiosity about animals or other natural objects giving place to a fit of theological inquiry; this, again, being dropped for an equally eager inquiry into the making of clocks, railway engines, and so on. Yet through these alternating bouts of questioning we can distinguish something like a law of intellectual progress. Questioning as the most direct expression of a child's curiosity follows the development of his groups of ideas and of the interests which help to construct these. Thus I think it a general rule that questioning about the make or mechanism of things follows questioning about animal ways just because the zoölogical interest (in a very crude form, of course) precedes the mechanical. The scope of this early questioning will, moreover, expand with intellectual capacity, and more particularly the capability of forming the more abstruse kind of childish idea. Thus, inquiries into absolute beginnings, into the origin of the world and of God himself, indicate the presence of a larger intellectual grasp of time relations and of the processes of becoming.

Our survey of the field of childish questioning suggests that it is by no means an easy matter to deal with. It must be admitted, I think, by the most enthusiastic partisan of children that their questioning is of very unequal value. It may often be noticed that a child's "Why?" is used in a sleepy, mechanical way, with no real desire for knowledge, any semblance of answer being accepted, without an attempt to put a meaning into it. A good

deal of the more importunate varieties of children's questioning, when they follow up question by question recklessly, as it seems, and without definite aim, appears to be of this formal and lifeless character, an expression not of a sound intellectual activity, but merely of a mood of general mental discontent and peevishness. In a certain amount of childish questioning, indeed, we have, I suspect, to do with a distinctly abnormal mental state, with an analogue of that mania of questions or passion for mental rummaging or prying into everything—*Grübelsucht*, as the Germans call it—which is a well-known phase of mental disease, and in which the patient will put such questions as these: "Why do I stand here where I stand?" "Why is a glass a glass, a chair a chair?"* Such questioning ought, it is evident, not to be treated too seriously. We may attach too much significance to a child's question, laboring hard to grasp its meaning, with a view to answering it, when we should be wiser if we viewed it as a symptom of mental irritability and peevishness, to be got rid of as quickly as possible by a good romp or other healthy distraction.

To admit, however, that children's questions may now and again need this sort of wholesome snubbing is far from saying that we ought to treat all their questioning with a mild contempt. If now and then they torment their elders with a string of random, reckless questionings, in how many cases, one wonders, are they not made to suffer—and that wrongfully—by having perfectly serious questions rudely cast back on their hands? The truth is, that to understand and to answer children's questions is a considerable art, including a large and deep knowledge of things, and a quick, sympathetic insight into the little questioners' minds. It is one of the tragi-comic features of human life that the ardent little explorer, looking out with wide-eyed wonder upon his new world, should now and again find as his first guide a nurse or even a mother who will resent the majority of his questions as disturbing the luxurious mood of indolence in which she chooses to pass her days. We can never know how much valuable mental activity has been checked, how much hope and courage cast down, by this kind of treatment. Yet happily the questioning impulse is not easily eradicated, and a child who has suffered at the outset from this wholesale contempt may be fortunate enough to meet, while the spirit of investigation is still upon him, one who knows and who has the good nature and the patience to impart what he knows in response to a child's appeal.

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* See W. James, Psychology, vol. ii, p. 284.

THE AMERICAN CHAMPAGNE DISTRICT.

By LEE J. VANCE.

TWO hundred years ago a pious monk, Dom Perignon by name, held the post of cellarer to the fraternity of monks of the Order of St. Benedict, in the hamlet of Hautevillers, situated on the river Marne, four or five miles from Epernay and about fifteen miles from Rheims. His was an important position, for the revenues of the abbey depended entirely on its vineyards, and consequently on the taste, judgment, and skill of its cellarer. Consider what this pious monk did to increase the revenues of the abbey.

The important contributions that Dom Perignon made to the art of wine-making were the result of observations and experiment. Thus, he noticed that the wine which was made from the grapes growing in the different vineyards of the district showed, as might be supposed, different characteristics. For example, the black grapes produced a white wine that improved with age, instead of turning yellow and deteriorating as did the wine made from white grapes. This set Dom Perignon to thinking. Then the happy idea suggested itself to him of "marrying" the different wines produced in the vineyards of the district. Why not blend the juice of the black grapes with that of the white grapes? Now, Dom Perignon, be it said, was an artist. He tried many different mixtures until he obtained one or two wines that satisfied his nice and cultivated taste.

If Dom Perignon had been content to manufacture wine by the ancient and time-honored methods of his predecessors, he would never have discovered the light, sparkling wine which has made the Champagne district of France known the world over. His first discovery, the blending of certain wines, which was the result of care and thought, led in turn to his second and greatest discovery—the secret of sparkling wines—which, oddly enough, came by accident. One day a tightly corked bottle in the cellar exploded, and lo! to the monk was revealed the mystery of effervescence, and *vin mousseux*—what we call champagne—was the glorious result.

The new wine met with immediate favor and great success. It revolutionized the art of wine-making; it was a revelation to wine-drinkers. Sparkling wine was so far beyond the old-style still wine that the two could not be compared in the same breath. The delicious and original qualities of *vin mousseux* are a fine color, a snap, a sparkle, and "beaded bubbles winking at the brim," a quick, fleeting taste to the tongue, an almost imperceptible bouquet, and last but not least a subtle, exhilarating effect.

FIG. 1.—TYING GRAPES IN SUMMER.

The straw-white wine from the Champagne district, especially from Hautevillers, became famous during the reign of Louis XIV. The king contributed to bring the new wine into fashion by having it on the royal table. The great wine connoisseur of the day, Marquis de Sillery, at a *souper d'Anet*, introduced champagne in flower-wreathed bottles, which, at a given signal, a dozen blooming damsels in the guise of Bacchanals placed upon the table.

Thus heralded, champagne became *par excellence* the wine of civilization. So Talleyrand in his epigrammatic way called it, "*vin civilisateur par excellence.*" In England, at the beginning of the present century, champagne was the necessary adjunct to all public and private banquets. No formal affair was complete without it. And yet, ninety, eighty, seventy, or sixty years ago the amount of champagne made and required was comparatively small. Indeed, it is only within the last forty or fifty years that the consumption of champagne has increased by "leaps and bounds." It has increased fourfold within thirty years; it has doubled within the past fifteen years; and in this connection, it is significant to note that the growing demand for champagne has come, not from France, but from foreign countries, principally from Russia, England, and America. Five times as much champagne is required outside of France as is used for home consumption.

The extraordinary demand for champagne stimulated the wine-makers of other grape-growing districts and of other countries to produce a genuine *vin mousseux*. The result is, there are many *sparkling wines*—for example, the sparkling wines of Germany and Austria—but only one kind of champagne, and that is made in the Champagne district of France.

The earliest attempt at the manufacture of champagne on a commercial scale in the United States was made in Ohio about the year 1850. At that time there were extensive vineyards in the Ohio Valley. The pioneer and promoter of an American champagne industry was the Hon. Nicholas Longworth, of Cincinnati. He procured expert and capable wine-makers, and imported improved machinery and appliances from the Champagne district of France. He was fairly successful in making a sparkling Catawba wine. For several seasons—that is, from 1862 to 1865—the vines were attacked by pests and fungoid diseases; the vineyards of the Ohio Valley were destroyed, and the champagne business ruined. Since then the grape and wine industry has been transferred to the northern part of Ohio, along the shores of Lake Erie, and a small amount of champagne is now made at Kelley's Island, Toledo, and Sandusky; also at St. Louis, Mo.

Meanwhile the lake region of central New York was rapidly coming to the front as the land of vineyards. We refer to the

country around three lakes—Keuka, Seneca, and Canandaigua. The grape industry was started along Lake Keuka about fifty years ago. The first outdoor grapes were shipped to the New York market about 1847–'48 by the way of the Erie Canal. In 1860 the Lake Keuka grape industry was well rooted, and there were planted and in bearing about 250 acres.

At the present time there are about 16,500 acres of vineyards in the Lake Keuka district. To this should be added about 10,000 acres of vineyards in the Seneca and Canandaigua districts, making a total of 26,500 acres in the lake region. In the western part of the State is the Chautauqua district, which contains about 18,000 acres of vineyards. The Hudson River district, which was established about 1860, has about 14,000 acres of vines.

In 1890,* when the statistics of viticulture were gathered for the first time in the United States, it was found that New York State, with one fourth of the acreage of California, raised almost twice as many table grapes as the latter State. In other words, four fifths of the grapes grown in New York are for table purposes, while in California four fifths of the grapes are made into wine.

The American champagne district, as the Lake Keuka region has been known for some time, is fairly entitled to its name. More and better champagne is produced annually in this district than in any other section of the United States. The first wine company, the Pleasant Valley, was formed in 1860, and a few years later began making champagne. In 1865 the Urbana Wine Company was organized, with the object of making a superior American champagne. These two cellars each carry a stock of 1,000,000 bottles of champagne. There are five other cellars in the district, all making champagne, and ranging in capacity from 30,000 to 150,000 gallons.

East of the Rocky Mountains no champagne in any quantity is made outside of Ohio and New York. West of that great range considerable champagne has been made in one section of California, but the Eastern product is regarded by connoisseurs as more nearly approaching in quality the best French product. There is, and will be, a difference between the best American and French champagnes, owing to the variety of grapes and soils, but outside of that, as a chemical analysis will show, the difference is no greater than that between French champagnes produced in the several localities of the Champagne district.

It is now well understood that the golden qualities of *vin*

* In that season the New York growers shipped to market the enormous quantity of 60,687 tons, or 121,374,000 pounds, of table grapes, while California sold only 38,785 tons for the same purpose.

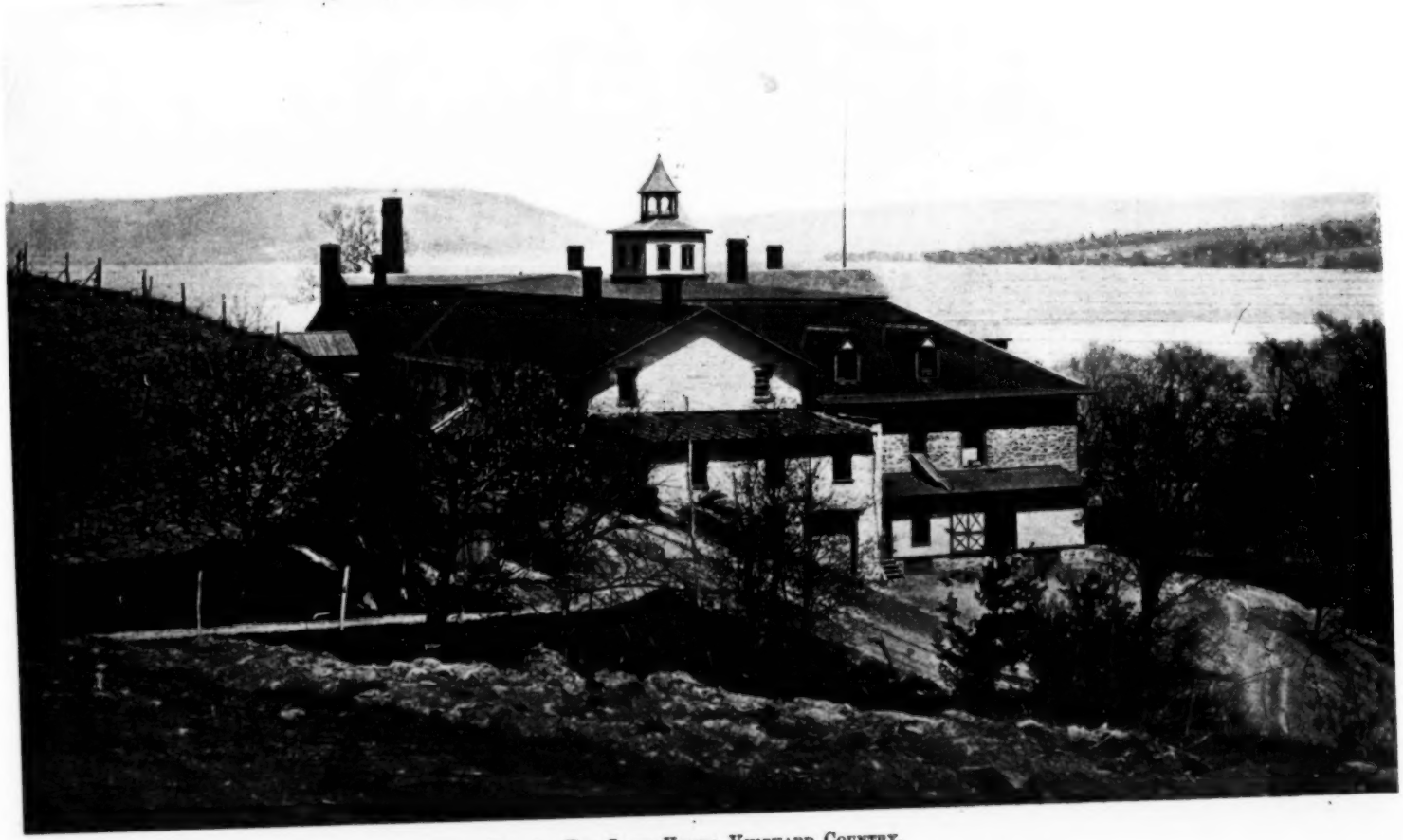

Fig. 2.—The Lake Keuka Vineyard Country.

mousseux may be attributed to three elements: (1) The variety of grape; (2) the soil and climatic conditions; and (3) the manipulation. The grapes of which the French wine is made grow on a soil which is peculiar in its mixture of chalk, silica, light clay, and oxide of iron. The surface of the champagne district is composed of light clay and pebbles, and the vine flourishes best where the soil appears most sterile. Hence, while the grapes for champagne contain but little sugar, they draw from the earth those chemical elements that give certain peculiar qualities to the wine.

When viticulture was introduced into this country, more than one hundred years ago, efforts were made to grow the European varieties of grapes east of the Mississippi. With few exceptions, these foreign varieties turned out to be failures. Then our Eastern viticulturists directed their attention to the improvement of native vines. By dint of experiment after experiment they have succeeded in developing some of the choicest and most valuable varieties of grapes known—varieties good for the table as well as for wine-making.

The two great native grape stocks are the Concord and the Catawba. From the seedlings of the Concord we have obtained Worden, Moore's Early, Pocklington, Martha, and other well-known varieties. The Concord is also one parent of Niagara, El Dorado, Brighton, etc. From the Catawba we have obtained Iona, Diana, Excelsior, etc. The Delaware and Isabella have given us a few good varieties. Some idea of the varieties of native grapes can be gained from the statement that two hundred and seventy-five varieties of grapes were sent by Eastern growers to the horticultural exhibit at the World's Fair, Chicago.

The wonderful improvement of our wild American grapes is striking testimony to man's power of selection. He has transformed sourish, harshly flavored wildlings into sweet, luscious fruit. In this process there has been an evolution of the sense of taste. Our grandfathers and fathers ate sour grapes, but the children's teeth have not been set on edge, because they eat sweet grapes. The difference between a lemon and an orange represents the improvement of the grapes of the present day over the grapes of fifty years ago.

Somewhat different has been the history of viticulture in California. There, efforts to grow the European varieties of grapes were successful from the first. The California growers did not have to experiment with native vines. Numerous varieties of the foreign species *Vitis vinifera* were planted and cultivated, and, in the right climate and soil, they showed their Old World characteristics. Many of the choice kinds of French, German, Italian, and Spanish types seem to come nearer to reproducing themselves here than elsewhere.

California may be divided into three grape-growing sections: (1) The coast, (2) the Sierra Nevada foothills and Sacramento Valley, (3) the southern counties. In the first district are grown varieties of French champagne grapes, from which are produced large quantities of sparkling wines. The Sierra Nevada foothills are best adapted, as the Director of the Experiment Stations has pointed out, to the growing of sherry, port, and raisin grapes, while the slopes and valleys of the Coast Range must be looked to for wines of the claret, burgundy, and sauterne types.* The southern district of California excels in sweet wines and brandies. Here the Muscat varieties are grown for table use and for raisins.

Thus, the differences between the two great grape-growing sections of the United States are clearly defined. The grapes raised in New York and Ohio—in fact, all those raised east of the Rocky Mountains—are native varieties and contain but little sugar. They yield the delicate table wines and champagne. The grapes raised west of the Rockies, especially in California, are European varieties and are heavy in sugar. They produce brandies, the demi-liquor wines, such as sauterne, and the heavy liquor wines, such as sherries, madeiras, and ports. Hence the methods of wine-making in California are quite different from those in Eastern States.

The Eastern district possesses many points in common with the French vineyard districts. The Lake Keuka country is a fine grape-growing region, owing to the peculiar climatic and other natural advantages that it enjoys.

Here is the proper place to observe that the best grape localities or climates are those where dews are light or altogether absent. It is a matter of experience that grape culture has become popular and profitable only in such localities. It is so in the champagne district of France along the river Marne, or in the Medoc district stretching north from Bordeaux between the sea and the rivers Garonne and Gironde, and in Germany along the river Rhine. It is so in the United States, along the Hudson River, along the lakes of central and western New York, and in the strip of territory extending along the shores of Lake Erie. In all of these grape-growing regions the vines are exempt from heavy or frequent dews and fogs, on account of the presence of considerable bodies of water.

It is to these climatic conditions that the Lake Keuka grape industry owes its success. The vineyards are always under the protecting presence of Lake Keuka, and under the guard of the high hills that surround it. Here the grape is enabled to escape

* See report for 1889.

its most dangerous enemy—early frost. The spring comes late, as the crust of ice on the lake keeps the water and air cold, and retards the opening of the buds until the usual danger of frost is past. The water exerts a similar favorable influence in autumn, by retaining the heat collected during the summer, so that the fruit is protected from early frosts in September. The presence of this stratum of air is shown by the absence of light frosts during late autumn, and by the greenness of the foliage where the

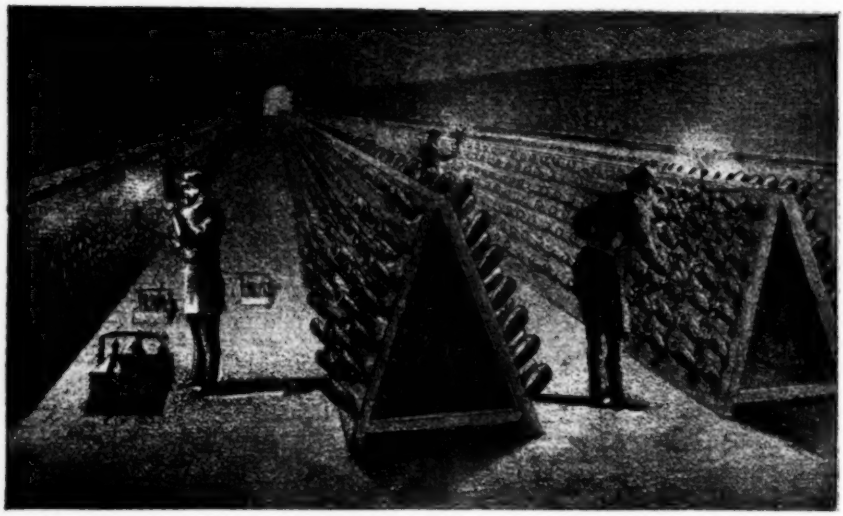

FIG. 3.—CHAMPAGNE VAULT.

warm breezes from the lake extend. There is a difference of from six to ten degrees between the temperature near the lake and that on the hilltops.*

The soil is also another important factor in the successful growing of grapes. The surface of the Lake Keuka hillsides is composed of gravel and shale on calcareous rock. It looks bare, having been washed off by rainstorms and freshets centuries ago. There are places where vegetation is stunted, and where weeds find no great encouragement; and yet the finest Catawba vines flourish in soils that appear little better than gravel beds. You wonder how grapes can grow and sweeten on such ground. The reason is, that in such earth the soil retains the sun's heat long

* The influence of water in ameliorating climate is seen in the varieties of native grapes that flourish in certain localities. The *labrusca* stock is a native east of the Alleghany Mountains, and is suited to a moist climate. It does not do well or flourish in the dry regions of the Western and Southwestern States. The *bourquiniana* varieties, such as *herbemont*, are eminently dry climate grapes. The *æstivalis* of the South and the native viparias of the Northwest are best fitted to their environment.

after sundown, so that the work of fructification goes on silently by night as by day.*

A few words as to the methods of cultivation that obtain in the Lake Keuka district. The vines are set from six to eight feet apart, and are trained to run on trellises. Three lines of wire are stretched from stakes, which are about eight feet distant from each other. The vines begin bearing in the third year, and the yield increases until the fifth and sixth years, when a vineyard is said to be in full bearing. The life of a vineyard is often three score and ten years, so that with good care and attention the children may reap from the vines their fathers planted. The average yield is about two tons of Catawba grapes to the acre, while the Concords will often go four tons to the acre.

In the fourth year the vine, if it has made good growth, is trimmed with two arms. The method of training is known as the "horizontal arm and spur system." By this system two main horizontal branches, or canes, are trained permanently to the lower wires—one to the right, another to the left. The upright shoots, that grow from the two main arms each season, are cut back each fall or winter to upright "spurs." The strongest new shoots that spring from these spurs in the spring are left for the bearing wood of that season, and this new cane is headed back to the top wire of the trellis. A strong vine will carry four shoots on each arm, or eight in all, care being taken not to overload the vine.

The method of pruning is known to growers as the thorough renewal system. When the spurs on the two main arms become overgrown or rank, they are renewed from new shoots, which spring from the arm, or near the base of the vine. Sometimes the arm itself is renewed from the head of the vine, or from a point near the ground. Summer pruning consists in thinning the vines here and there, and cutting off damaged clusters and imperfect berries.

As soon as the frost is out of the ground the grower goes through his vineyard to see if it has wintered well—that is, if post, wires, and vines are in good shape. A few weeks later, the canes are tied by willow bands to the lower wire. During May and June the vineyard is plowed and the roots grubbed. The first

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* The peculiar climatic and other natural advantages of the Lake Keuka region are summed up by William Saunders, Government Superintendent of Gardens and Grounds, as follows: "Here the Catawba and other late grapes mature and reach remarkable perfection, taking the latitude into consideration. These vineyards are mostly on the hillsides extending for several hundred feet above the valley and surface of Keuka Lake. The soil is a drift formation, and the surface is thickly covered with loose shale. The marked adaptability of this locality for grape culture may be attributed to its elevation and nature of the soil."—(*Report of Secretary of Agriculture for 1889, p. 113.*)

plowing is away from the vines, and in the second and third it is toward the vines. During the summer the vines grow vigorously, and the climbing offshoots are tied by straw bands to the second and third wires.

The algebraic x stands for the unknown quantity in grape-growing—for bad weather, diseases and pests. A few years ago the Lake Keuka vineyards were attacked by "black rot." At one time it looked as if the industry would be wiped out as completely as it was in the Ohio Valley thirty years ago. But the remedy known as the "Bordeaux mixture" proved to be the salvation of the grape-grower. It is a composition of six pounds each of sulphate of copper and lime to fifty gallons of water. This is sprayed

FIG. 4.—FINISHING CHAMPAGNE.

on the vines three times during the season: first, when the blossoms begin to appear; second, just after blossoming and when the fruit has set; third, when the grapes are partly grown. For the last spraying many growers use a copper carbonate ammoniacal solution.

The vintage begins the first week in September and lasts until the third week in October. It depends, of course, on the weather and on the kind of grapes grown. The Delawares ripen first, then the Concords, while the Catawbas seldom mature before the first week in October. The grape crop is picked in boxes which hold from thirty to forty pounds. When filled they are carried to the

end of the rows, and there gathered two or three times a day and drawn to the packing house. The fruit that is not packed in boxes for market is stored in crates or on trays and, by proper ventilation and temperature it can be kept fresh and fair for several months. This gives the grower a long range of season, and choice table grapes are supplied from October till the following March or April.

This grape-picking time is a kind of long and pleasant picnic—all the more pleasant for being a busy one. The men and women look forward to it from year to year as a chance to earn money to carry them through the winter, while the young people regard the season as one of recreation and enjoyment. The most expert pickers are the women and girls. They come from the neighboring farms and country villages. The usual rate of wages is one dollar per day without "board," or three dollars per week with board.

The Lake Keuka grape crop is sent to market in small baskets. Last year (1893) the number of cars shipped from the district was not less than 2,200. As each car holds from 2,500 to 2,700 baskets, the reader can form some correct idea of the quantity of grapes produced annually in this one district. The bulk of the crop is sent to the Eastern cities—New York, Philadelphia, and Boston. The growers send table-grapes as far west as Omaha and Denver, and last season several carloads were shipped to the Northwest, and even to Manitoba.

At the present time the wine cellars take a very small per centage of the total crop. It is estimated that the twelve wineries in the Keuka Lake district use from 5,000 to 6,000 tons of grapes during the season. There is now an overproduction of grapes for table purposes. The growers look to the growing wants of the wine cellars to take their surplus crop. With the increasing demand for American wines, especially for champagne and delicate table wines, the time should be not far distant when the output of the cellars will be ten times as great as it is to-day.

Of course, the reader will be interested in learning how the pure, sweet juice of the grape is converted into lively, sparkling champagne. There is more or less of a veil of secrecy thrown around the ways and methods of the champagne-maker; for he is an artist and does not wish to disclose the mysteries of his art. What follows concerning the various processes through which the wine goes in its successive stages is the result of a visit made last autumn to the largest establishment of its kind in the United States.

The building of A. B. & Co. is on the shore of the lake, and, being constructed of huge blocks of quarried stone, looks like a mediæval castle. The outside gives one little notion of the size and capacity of the establishment. There are fourteen separate

vaults, or cellars, and these extend far under the hill. Together they are one hundred and thirty-two feet long and one hundred and five feet wide. Stored underground are one million bottles of champagne made by the French method—i. e., by fermentation in the bottle.

You enter: the nostrils are tickled with the odor of the wines. You see the vats heaped full with luscious grapes; the two double wine presses are working and squeezing out the life-blood of the berries; the liquid stream is pouring into large tanks; the men are bare-armed, their hands and faces smeared with red stains—you see this, and can imagine Bacchus and his merry crew holding high carnival.

This new wine, or "must," after it deposits its lees in the course of a few days, is run into casks holding from two to four thousand gallons each. Here it remains for six or eight weeks—that is, until it has passed through its first fermentation. Then it is racked off into other casks, and is now ready for mixing.

The composition of the blend is, of course, one of the secrets of the art. The French wine-maker mixes the juice of black grapes with that of white grapes in the proportion of three to one. The American wine-maker does about the same. He takes juice of the black Concord and Isabella grapes and mixes it with that of the red Catawba, Iona, and Delaware grapes. The great point is to get the right amount of saccharine matter, so as to cause neither too much nor too little effervescence: if too much, the bottles break afterward; if too little, the wine becomes dull, flat, and insipid. Thus the *cuvée* is effected. Think of the delicacy of taste required in order to *know* what the juices of many different grapes will bring forth two years hence! The mixture is put into casks in which it undergoes the process of fining, and then it is ready for bottling. After being bottled, the wine is kept in a semi-warm room until fermentation is well begun. The bottles are then carried to the deep, cool vaults, where they are packed in horizontal layers, making a pile four or five feet deep and twelve or fifteen feet long. Thus the bottles remain until the wine within is fully ripe—a period of from twelve to eighteen months.

It is important that the vaults be kept at an equable temperature. This is accomplished by the cold storage system, and the thermometer will not show a variation of more than three degrees throughout the year. The bottles are of great strength and of foreign make. The loss from breakage is always considerable, ranging from five to fifteen per cent. It is one of the items of the extra expense of champagne; the others being the quality of the juice, the care and manipulation required, and the capital invested for two or three years.

When champagne is considered fully ripened, the bottles are

placed upon clearing tables, or racks, the necks pointing obliquely downward, in order that the sediment which has been formed during fermentation may work down upon the cork. Twice a day for three or four weeks the workmen give the bottles a quick little shake, and turn them partly around and down. At the end of this time the sediment is in the neck of the bottle, while the body of the wine is clear.

Now the bottles are taken to the finishing room, cork down, and the sediment is "disgorged." The workman cuts the cord holding the cork, and zip! out shoots the sediment with a report. The bottle is quickly placed on a machine and supplied with a temporary cork.

The wine in this state is raw—*vin brut*—without any *liqueur*. It is sharp and not cloying to the taste. It must be sweetened. So the bottle is placed in a machine, and a spoonful of *liqueur* is injected into it from a graduated glass tube or reservoir. This "dosage," as it is called, is simply pure sugar crystal dissolved in old wine or fine brandy. The dry champagne which the English and Americans like contains from four to eight per cent of *liqueur;* the Russians like sweet champagne, which has from fifteen to twenty per cent of *liqueur*.*

The bottle is permanently corked, and passed to a workman who ties in the cork and fastens wire around it. An ingenious capping machine puts on the pretty gold and silver foil that decorates the bottle, and finally the label is pasted on and the wine cased.

Such, in brief, are the successive stages through which champagne must pass ere it reaches the table with a bird and is called a "cold bottle." During these processes each bottle has been handled about two hundred times, and the transition from the grape to the finished product has taken two years and a half of time. There is, however, a short cut to champagne. Man does in a few days or a week what it takes Nature to accomplish in two years. He forces carbonic gas into the wine, and he even imitates closely the different bouquets. All is not champagne that sparkles.†

Champagne! There is an indescribable charm over, around, and about thee. The very word suggests glitter and bubble and

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* The word "dry" is used by wine-growers to indicate natural-juice wine, such as claret or Rhine wine, in which no sugar is left after fermentation. As applied to champagnes, "dry" is used to indicate the degree of sweetness, as "dry" and "extra dry" or "special dry." We do not undertake to pass on the comparative merits of the French and American champagnes.

† The apparatus for charging wine and formulas for imitating bouquets are given in Antonio dal Piaz's book, Die Champagner-Fabrikation und Erzeugung imprägnirter Schaumweine. Wien, 1892.

sparkle. It brings to many of us a flood of recollections: pleasant company—bright eyes and rosy cheeks—laughter, sunburned mirth, and Provençal song—the feast of reason and flow of soul—the flow of words, repartee and banter—after-dinner speeches, and dull, formal dinners—all jumbled together. Even at this late day many a Cassio listens to the voice of the tempter Iago, who says: "Come, come; good wine is a good familiar creature, if it be well used; exclaim no more against it!"

SOME LESSONS FROM CENTENNARIANS.

By J. M. FRENCH, M.D.

AN examination of the Massachusetts registration reports reveals some facts with reference to centennarians which are of interest, both in themselves considered and as illustrating some of the conditions favorable to great longevity.

The whole number of persons who died in Massachusetts during the ten years from 1881 to 1890, inclusive, at the age of one hundred years or over, was 203. The whole number of deaths reported during the same time was 394,484, making the proportion of centennarians one for every 1,928 of all deaths reported.

Dr. Farr, the celebrated English registrar general, in his March of an English Generation through Life, states that out of every 1,000,000 persons born in England only 223 live to the age of one hundred years. This is one in 4,484, or less than one half the proportion in Massachusetts. It must be remembered, however, that in respect to certain elements the conditions in the two cases are not parallel; inasmuch as, in the first place, the returns of deaths, especially of infants and young children, are much less complete in Massachusetts than in England; and, in the second place, a large proportion of persons of the younger ages are constantly going out from Massachusetts to settle in the newer portions of our country, leaving an abnormally large proportion of aged persons. Nevertheless, after all allowances have been made, the proportion of centennarians in Massachusetts is unexpectedly large, and leads to the belief that its climate and conditions of life are favorable to longevity.

The average age of these 203 centennarians was one hundred and two years, five months, and twenty-five days. One hundred and sixty-five were between one hundred and one hundred and five, thirty-one were from one hundred and five to one hundred and ten, seven were from one hundred and ten to one hundred and fifteen, and one was one hundred and eighteen years of age.

The next fact which claims our attention is that, of these 203

persons, 153 were females and only 50 males—that is, more than three times as many women as men reached the age of one hundred years. This proportion does not vary greatly from that which has been reported in other cases. Thus, in New York city, out of 111 persons dying at the age of ninety years or over, 77 were females and 34 males—a proportion of two and one fourth to one. The Morning Post of London has tabulated all the cases of exceptionally long life which were reported in its columns during the year 1892, and finds that the octogenarians numbered 1,151, of whom 646 were females and 545 males. Above the age of eighty the proportion of females rapidly increases, so that at the age of one hundred or over there are five times as many women as men. Dr. Farr states that of males living at twenty, one in three reaches seventy, one in eight reaches eighty, and one in seventy reaches ninety; while of females living at twenty, one in two and two fifths reaches seventy, one in six and three fourths reaches eighty, and one in forty-nine reaches ninety. Hufeland, in his Art of Prolonging Life, lays down the law that "more women than men become old, but fewer very old." The first part of this law is abundantly sustained by the results obtained in all these cases. As to the latter portion, judging from these figures, it is open to question. In Massachusetts the average age of the 50 males exceeded that of the 153 females by about nine months; but of the eight persons who were over one hundred and ten years two were males and six females—still three to one; and the oldest of all was a female, who had attained the great age of one hundred and eighteen years. This advantage on the part of the female sex—and a considerable advantage we must admit it to be, when we consider that there are nearly five per cent more males born than females, and only one third as many living at the end of a century—is probably due in part to the fact that women as a class have a more favorable environment than men, leading more quiet and regular lives, having fewer bad habits and forms of dissipation to sap their vitality, and being less exposed to death by violence and by accident; and in part to a greater endurance and tenacity of life which are inherent in the female sex.

Considering next the element of *marriage*, we find that 184 had been married one or more times, 14 had never been married, and concerning 5 the facts were not stated. Leaving out of account the latter class, there were thirteen times as many married as unmarried. In the absence of statistics showing the relative proportion of married and unmarried persons in the community at large, it is impossible to determine the proportion of centennarians in each class; but it may be considered as quite certain that the married reach the age of one hundred years in greater

ratio than the unmarried. The average age of the married exceeded that of the unmarried by about fourteen months. This coincides with the results obtained from other sources. So far as I know, all statistics show a smaller mortality rate and a greater longevity among the married than the unmarried. Mr. Darwin urges matrimony as one of the greatest aids to long life, and calls attention to a mass of statistics gathered in France, showing that unmarried men die in far greater proportion than married. Dr. Stark says that bachelorhood ought to be classed with the most unwholesome trades, or with a residence in the most unwholesome districts, so far as danger to life is concerned; and he presents statistics showing that in Scotland the death rate of unmarried men of certain ages was 15 per 1,000 annually, while that of the married men of the same ages was less than half as great. Hufeland says that "all those people who became very old were married more than once, and generally late in life. There is not one instance of a bachelor having attained a great age." Massachusetts statistics present no instance of what may be termed remarkable age, the oldest being one hundred and eighteen, and married; nor do they show whether the individuals mentioned had been married more than once, or late in life. But it is undoubtedly true that the more regular habits and better hygiene of the married, their less degree of exposure, more abundant home comforts, better food in health and better care in sickness and approaching age, together with the moderate and restricted gratification of the sexual appetite—in short, those elements which constitute the environment of the individual—are more favorable to longevity than are the corresponding elements in the unmarried.

Whether this is true in an equal degree of both sexes, however, is more than questionable. Among the Massachusetts centennarians one in eleven of the women had never been married, while among the men the corresponding proportion was only one in twenty-three. Further than this, while there were three times as many women as men among the centennarians as a whole, there were six times as many among the unmarried ones. It would seem to be a fair inference that the effect of celibacy is less fatal to longevity among women than men. Nor is this other than might be expected, when we consider how helpless and dependent is an old man, and how unable to care for himself in the little niceties of life which contribute so largely to health and comfort, and how much less so in all these respects is an old woman.

But it would be a manifest error to conclude that, because the average age of the married exceeds that of the unmarried, therefore this excess of longevity is due to the married state, unless it can first be shown that the individuals composing the two classes

were originally in the enjoyment of the same degree of health and soundness of constitution; whereas, it is an indisputable fact those persons entering the married state are, as a whole, more robust and enduring, and hence have a greater natural expectation of life, than those who remain single; and it is also evident that repeated marriages, and especially marriages late in life, are indications of a greater than usual degree of vigor and vitality. They are therefore in the nature of an effect, rather than a cause, of extreme longevity.

Coming now to the subject of *nativity*, we find that 85 were native-born, 115 were foreign-born, and of three the birthplace was unknown. The average age of the native-born was one hundred and two years and twenty-seven days; and of the foreign-born one hundred and two years, nine months, and eleven days. Again, statistics are lacking to determine the relative number of natives and foreigners in the State as a whole. But as it can hardly be supposed that the foreign outnumbers the native population, these figures would seem to show an advantage on the part of the foreign-born, both in average age and in proportionate number of centennarians. This may be partially explained on the ground that the immigrants who came to this country from fifty to one hundred years ago, when the country was comparatively new and unsettled, would naturally be persons of more than the average vigor and endurance. Pioneers are of necessity a hardy race. The weak and sickly remain quietly at home, while the strong and hardy venture out into a new country and new conditions.

It must not be forgotten also that there is a source of possible fallacy in the ages given. It is proverbially difficult to obtain the exact age of ignorant persons, the tendency being more and more, as years advance, to exaggerate the real age. When to this is added the element of foreign birth, rendering a reference to birth records impossible, it is easy to see that there is a great liability that the ages given by the foreigners as a class were considerably in excess of the true ages.

Among the foreign-born the Irish carry off the palm as to numbers in the list of centennarians, as they undoubtedly do in the general population, furnishing 93 out of 115. Their average age exceeds that of the natives by about eight months, while it is exceeded by the other foreigners as a class by about four months.

As to color, 197 were white, with an average age of one hundred and two years, four months, and twenty-four days; and six were colored, with an average age of one hundred and five years, three months, and twenty-four days; while three of the six colored were over one hundred and ten years of age.

Now, it is an opinion generally held, and I think capable of

proof, that the death rate among these two classes, the Irish and the negroes, is much higher than that of the general population. I have not at hand statistics which will conclusively prove this fact, and will only quote the tables prepared by General Walker, based upon the United States census of 1870, in which he shows that while the Irish constituted three hundred and thirty-three per thousand of the foreign population, they contributed four hundred and ten to every thousand foreign-born decedents, thereby largely exceeding their due proportion.

If we accept the opinion alluded to as a fact, we are brought face to face with the paradoxical condition of a large proportion of persons reaching extreme longevity among classes noted for a low average longevity. How to account for this apparent anomaly is a question of interest. But one explanation suggests itself to me, and this I believe to be, in the main, the true one—namely, that the centennarians of the classes named owe their great age to favorable heredity, a natural life-force and power of endurance transmitted to them by their ancestors, which enabled them to withstand or overcome the unfavorable environment which carried off a large proportion of their respective races; while, on the other hand, the admittedly higher average longevity of the native whites is to be accounted for by their more favorable surroundings and mode of life, better hygiene in health and care when sick, whereby the vitality of the weak, the sickly, and the young is conserved, and many years of life are added to the average. If this explanation be accepted as the correct one, it suggests the law, which is also warranted by a wider observation, that *extreme individual longevity depends chiefly upon favorable heredity, while a high average longevity is promoted mainly by a favorable environment.*

As the result of his studies of the native calendar of Central America and New Mexico, with special reference to linguistics and symbolism, Dr. D. G. Brinton believes that the system of the peoples to whom it appertained was in a certain sense philosophic; that it grew out of ripe meditation on the agencies which direct and govern life; and that it was merely veiled—not smothered—in the symbolism which has been transmitted to us, and which they found it convenient to throw around it, in presenting it to the unlearned. The twenty potencies or agencies, fixed at that number for a reason which the author determines, follow each other in the sequence in which they were believed to exert their influence on the life or existence, not of man only, but of things and of the universe itself. This opinion exerted a strong constructive and directive influence on the national myths, rites, and symbolism, extending to architecture and ornament, to details of government, and to the every-day incidents and customs of national and domestic life. In all of these we perceive a constant recurrence of the signs and their correspondent numbers, drawn from the composite relations of twenty to thirteen.

THE HALF-BLOOD INDIAN.

AN ANTHROPOMETRIC STUDY.

By FRANZ BOAS.*

THERE are few countries in which the effects of intermixture of races and of change of environment upon the physical characteristics of man can be studied as advantageously as in America, where a process of slow amalgamation between three distinct races is taking place. Migration and intermarriage have been a fruitful source of intermixture in the Old World, and have had the effect of effacing strong contrasts in adjoining countries. While the contrasts between European, negro, and Mongol are striking, their territories are connected by broad stretches of land which are occupied by intermediate types. For this reason there are only few places in the Old World in which the component elements of a mixed race can be traced to their sources by historical methods. In America, on the other hand, we have a native race which, although far from being uniform in itself, offers a marked contrast to all other races. Its affiliations are closest toward the races of Eastern Asia, remotest to the European and negro races. Extensive intermixture with these foreign races has commenced in recent times. Furthermore, the European and African have been transferred to new surroundings on this continent, and have produced a numerous hybrid race, the history of which can also be traced with considerable accuracy. We find, therefore, two races in new surroundings and three hybrid races which offer a promising subject for investigation: the Indian-white, the Indian-negro, and the negro-white. The following study is devoted to a comparison of the Indian race with the Indian-white hybrid race.

It is generally supposed that hybrid races show a decrease in fertility, and are therefore not likely to survive. This view is not borne out by statistics of the number of children of Indian women and of half-blood women. The average number of children of five hundred and seventy-seven Indian women and of one hundred and forty-one half-blood women more than forty years old is 5·9 children for the former and 7·9 children for the latter. It is instructive to compare the number of children for each woman in the two groups. While about ten per cent of the Indian

* The material for this study was collected for the Department of Ethnology of the World's Columbian Exposition. Prof. F. W. Putnam, chief of the department, organized a Section of Physical Anthropology, in charge of the writer. It was one of the objects of this section to collect anthropometric material illustrating the racial characteristics of the North American Indians.

women have no children, only 3·5 per cent of the half bloods are childless. The proportionate number of half bloods who have one, two, three, four, or five children is smaller than the corresponding number of Indian women, while many more half-blood women than full-blood women have had from six to thirteen children. This distribution is shown clearly in Fig. 1, which

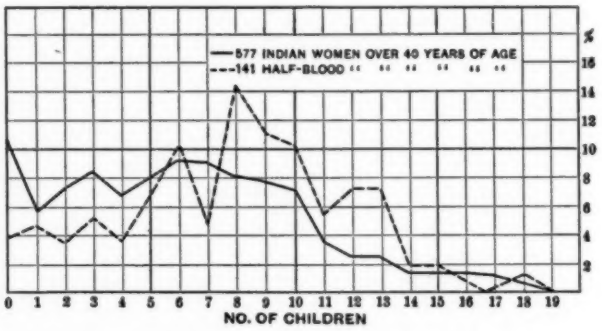

FIG. 1.—NUMBER OF CHILDREN OF INDIAN WOMEN AND OF HALF-BLOOD WOMEN.

represents how many among each one hundred women have a certain number of children. The facts disclosed by this tabulation show that the mixed race is more fertile than the pure stock. This can not be explained by a difference of social environment, as both groups live practically under the same conditions. It also appears that the small increase of the Indian population is almost entirely due to a high infant mortality, as under better hygienic surroundings an average of nearly six children would result in a rapid increase. It is true, however, that a decrease of infant mortality might result in a decreased birth rate.

Among the Indians of the Pacific coast the infant mortality is also very great, but we find at the same time a still larger proportion of women who bear no children.

It is of some interest to note the average number of children of women of different ages as indicating the growth of families. Among the Indians there is an average interval of four years and a half—as shown in the following table—which, however, must not be confounded with an average interval between births:

Indian women	20	years of age	have on the average	1	child.			
"	"	25	"	"	"	"	2	children.
"	"	28	"	"	"	"	3	"
"	"	33	"	"	"	"	4	"
"	"	38	"	"	"	"	5	"

Among the half bloods the interval is shorter, but the number of available observations is insufficient for carrying out the comparison in detail.

The statures of Indians and half bloods show differences which are also in favor of the half bloods. The latter are almost invariably taller than the former, the difference being more pronounced among men than among women. The white parents of the mixed race are mostly of French extraction, and their statures are on an average shorter than those of the Indians. We find, therefore, the rather unexpected result that the offspring exceeds both parental forms in size. This curious phenomenon shows

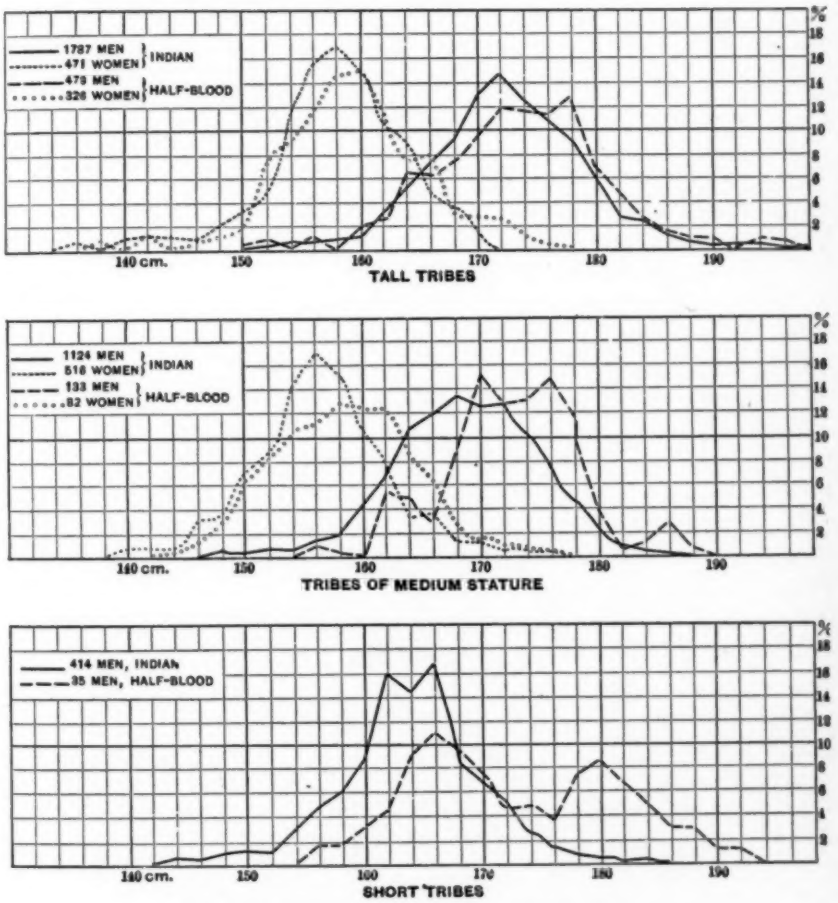

FIG. 2.—STATURES OF INDIANS AND OF HALF BLOODS.

that size is not inherited in such a manner that the size of the descendant is intermediate between those of the parents, but that size is inherited according to more intricate laws.

From investigations carried on among whites we know that stature increases under more favorable surroundings. As there is no appreciable difference between the social or geographical surroundings of the Indians and of the half bloods, it seems to

follow that the intermixture has a favorable effect upon the race.

The difference in favor of the half blood is a most persistent phenomenon, as may be seen by a glance at the following table:

Differences of Average Statures of Indians and Half Bloods.

Tribes.	Men, centimetres.	Women, centimetres.
Eastern Ojibwa	−0·1	0·0
Omaha	0·0	−0·7
Blackfeet	+0·1	.....
Micmac	+0·6	−0·2
Sioux	+1·0	+0·9
Delaware	+1·6	+0·4
Ottawa	+1·7	+0 4
Cree	+2·0	+2·8
Eastern Cherokee	+3·2	.....
Western Ojibwa	+3·2	+0·7
Chickasaw	+4·5	.....
Choctaw	+7·0	.....
Tribes of medium stature (165 to 169 centimetres)	+3·3	+2·5
Shortest tribes (less than 165 centimetres)	+8·3	+14·8

The last two entries in this table embrace mainly the Indians of the Southwest and of the Pacific coast.

The facts which appear so clearly in the preceding table may be brought out in a different manner by grouping all the Indian tribes according to their statures in three classes: those measuring more than 169 centimetres, or tall tribes; those measuring from 165 to 169 centimetres, or tribes of medium stature; and those measuring less than 165 centimetres, or short tribes. The frequencies of various statures in each of these classes have been plotted in Fig. 2. The horizontal line represents the individual statures from the lowest to the highest. The vertical distance of the curves from any point of the horizontal line shows how many among each one hundred individuals have the stature represented by that particular point. Thus it will be seen that 14·4 per cent of the full-blood men of the tallest class have a stature of 172 centimetres, while only 12·3 per cent of the half blood of the same class have the most frequent stature belonging to them —namely, 178 centimetres. Among the Indian women of the full-blood tribes 16·8 per cent have a stature of 158 centimetres, while only 14·4 per cent of the half bloods have their most frequent stature—namely, 160 centimetres.

This tabulation brings out the peculiarity that the statures of the half bloods are throughout higher than those of the full bloods; and that, at the same time, the most frequent statures are more frequent among the pure race than in the mixed race. This is expressed by the fact that the curves illustrating the dis-

tribution of statures among the half bloods are flatter than those illustrating the same feature among full bloods. This peculiarity may be noticed in all the curves of Fig. 2, with the exception of that of the men of the second group.

The statures near the average of each group are most frequent, and as these values do not occur as often among the half bloods

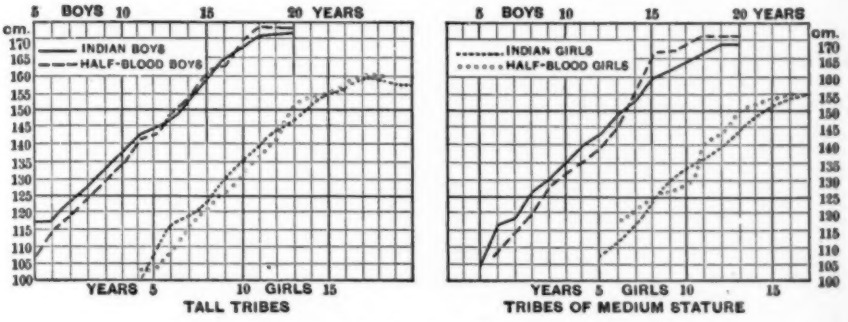

FIG. 3.—GROWTH OF INDIAN AND HALF-BLOOD CHILDREN.

as among the full bloods, the values which are remote from the average are at the same time relatively more frequent. Thus it becomes apparent that the mixed race is less homogeneous than the Indian race.

Another important phenomenon is revealed by a comparison of the growth of Indians and half bloods (Fig. 3). When the average statures of children of both races are compared, it appears that during the early years of childhood the Indian is taller than the half blood, and that this relation is reversed later on. This is found in both the groups for tall tribes and for tribes

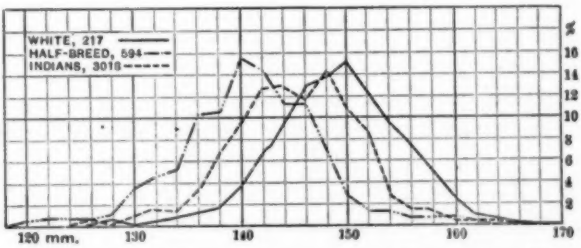

FIG. 4.—BREADTH OF FACE OF INDIANS, HALF BLOODS, AND WHITES.

of medium stature. It is to be regretted that this comparison can not be carried on for whites also. The social surroundings of the white child are, however, so entirely different from those of the Indian and of the half-blood children that no satisfactory conclusions can be drawn from a comparison. It is difficult to see why the laws of growth of the Indian and half blood should differ in this manner; why the Indian child at the age of three

years should be taller than the half-blood child, and then develop more slowly than the latter. This peculiarity is most striking in the growth of the tribes of medium stature, as in this case the difference in the statures of adults is so considerable. Unfortunately, we do not know if the same difference prevails at the time of birth; but even if this were the case the difference in the rate of growth would remain mysterious. The various phenomena described here merely emphasize the fact that the effect of intermixture is a most complicated one, and that it acts upon physiological and anatomical qualities alike. We observe in the mixed race that the fertility and the laws of growth are affected, that the variability of the race is increased, and that the resultant stature of the mixed race exceeds that of both parents.

One of the most striking characteristics of the Indian face is its great breadth as compared with that of the whites. It is therefore of peculiar interest to compare this measurement among the full-blood Indian, the half bloods, and the whites. The curves on

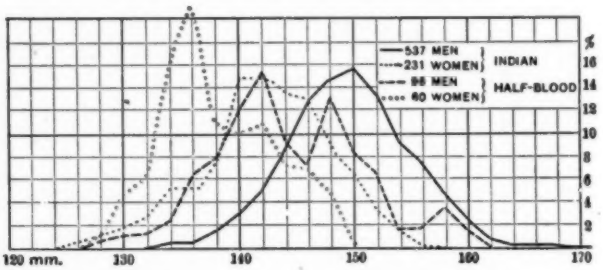

FIG. 5.—BREADTH OF FACE. Sioux.

Fig. 4 show the result of this inquiry. Among adult students of American colleges we find an average breadth of face (between the zygomatic arches) of 140 millimetres, while the average value among Indians is nearly 150 millimetres. The facial measurements of the half bloods are intermediate, the average value being nearer the typical Indian measurement and remote from the white measurement. We find in these curves also the peculiarity observed before—that the half blood is more variable than the pure race. This fact is expressed in the greater flatness of the curve.

It will be noticed that the central portion of the curve illustrating the distribution of the measurements of breadth of face of half bloods is markedly irregular, particularly that it shows a depression in its central portion. This might seem accidental, but it will be seen that in Figs. 5 and 6, where the same measurements for the Sioux and Ojibwas are given, the same phenomenon appears. We see in all these curves that the measurements which are near those of the parental races appear more frequently in the

mixed race than the intermediate measurements. It is true that the number of observed cases may seem rather small to draw this deduction with absolute certainty; but I have noticed that all tabulations of face and head measurements which include more than

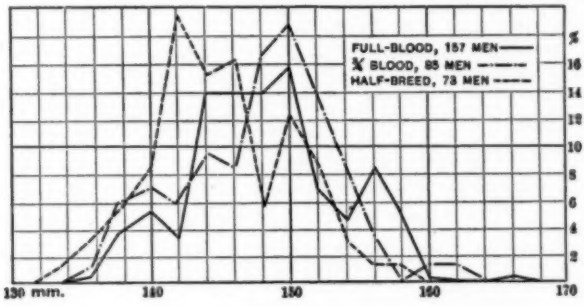

FIG. 6.—BREADTH OF FACE. Eastern Ojibwas.

five hundred individuals give very regular curves except in the case of half bloods, so that I believe I am justified in interpreting the phenomenon illustrated in Fig. 4 as a real one, and that it is not due to the small number of measurements. The correctness of this view can be proved definitely by an appropriate grouping of

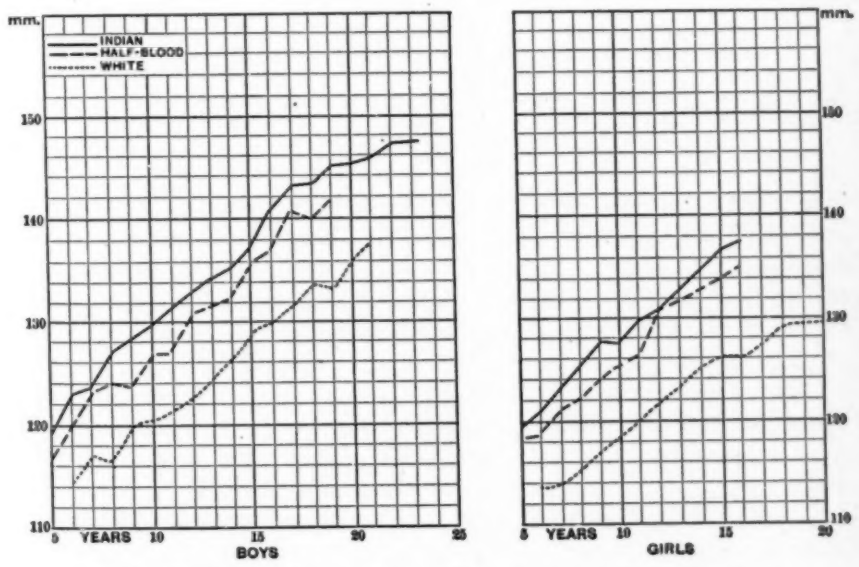

FIG. 7.—BREADTH OF FACE OF INDIAN, HALF-BLOOD, AND WHITE CHILDREN.

the available material according to the following point of view: The breadth of face and the breadth of head of man are closely correlated. The broader the head, the broader the face. Irregularities in the distribution of the measurement of the face will,

therefore, appear more distinctly when individuals are grouped together which have the same breadth of head. I have grouped the material in four classes, with the result that the double maximum of frequency, corresponding to the breadth of face of the parental types, appears more strongly marked in every class. Therefore we must draw the important inference that the face of the offspring has a tendency to reproduce one of the ancestral types—not an intermediate type. The effect of intermixture in this case differs, therefore, fundamentally from the effect observed in the measurements of stature.

When comparing the average breadth of face for Indians, half bloods, and whites, another interesting phenomenon may be seen. The average breadth of face of the half blood stands between that of the Indian and that of the white, but nearer the former. When computing this average from year to year, it is found that the same relation prevails throughout from the fourth year to the adult stage, and in men as well as in women (Fig. 7).

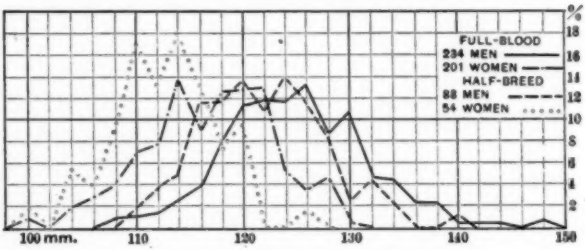

Fig. 8.—Height of Face. Sioux.

The relation of the three groups remains unchanged throughout life. The amount of white and Indian blood in the mixed race is very nearly the same. We find, therefore, the remarkable fact that the Indian type has a stronger influence upon the offspring than the white type. The same fact is expressed in the great frequency of dark hair and of dark eyes among half bloods.

Two reasons may be assigned for this fact. It may be that the dark hair and the wide face are more primitive characteristics of man than the narrow face and light eyes of the whites. Then, it might be said that the characteristics of the Indian are inherited with greater strength because they are older. It must, however, also be considered that half bloods are almost always descendants of Indian mothers and of white fathers, and this may have had an influence upon the race, although there is no proof that children resemble their mothers more than they resemble their fathers.

In carrying out the comparison of breadths of face it would be better to study the curves of distribution for each year, but the

number of observations is insufficient for applying this method. As stated before, the distribution of measurements is such that the parental types are more frequent than the average; for this reason the latter has no real biological significance. It must be

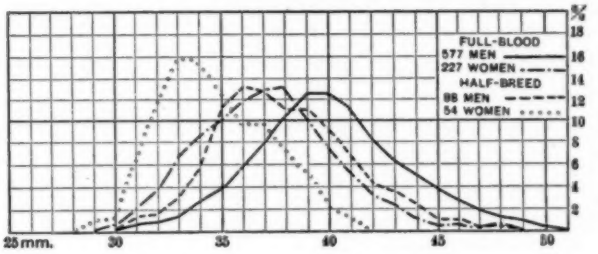

FIG. 9.—BREADTH OF NOSE. SIOUX.

considered merely as a convenient index of the general distribution.

Among the eastern Ojibwas I was able to make a classification into three groups: Indians, three-quarter bloods, and half bloods. In this case (Fig. 6) it will be noticed that the influence of the white admixture is very slight in the three-quarter bloods. The maximum frequency of the breadth of face remains at 150 millimetres, and we observe that a small increase in frequency takes place at 140 millimetres.

From the breadth of face I turn to the consideration of the height of face—i. e., the distance from the chin to the suture between the nasal bones and the frontal bone (Fig. 8). This measurement is subject to considerable variations, on account of the difficulty of determining the initial points of the measurement with sufficient accuracy. This accounts for the irregularity

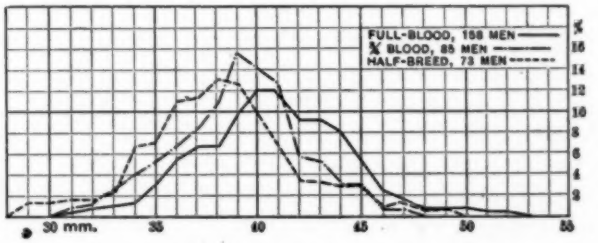

FIG. 10.—BREADTH OF NOSE. EASTERN OJIBWAS.

of the curves. It appears clearly that the face of the half blood is shorter than that of the white. I am not able to say if this phenomenon is due to a general shortening, or if the nose, the jaw, or the teeth contribute most to this effect. The difference between full blood and half blood is much smaller than in the case of the breadth of face.

The two measurements combined show that the Indian face is considerably larger than the face of the half blood, while the latter is in turn larger than the face of the white. As the head measurements of the tribes which have contributed to these statistics prove that there is no appreciable difference between these races regarding the size of the head, we are led to the conclusion that the Indian face is also relatively larger than that of the half blood and of the white.

Another characteristic difference between Indians and half bloods will be found by comparing the breadth of nose of both races. It is well known that the nostril of the Indian is round, and that it is bordered by thick alæ, while the nostril of the white is elongated and has fine alæ. Unfortunately, there are no measurements of the nose of the white available, but a comparison of the transversal breadths of the nose of Indian and half blood (Fig. 9) makes it clear at once that intermixture has the effect of making the nostril narrower and the alæ thinner,

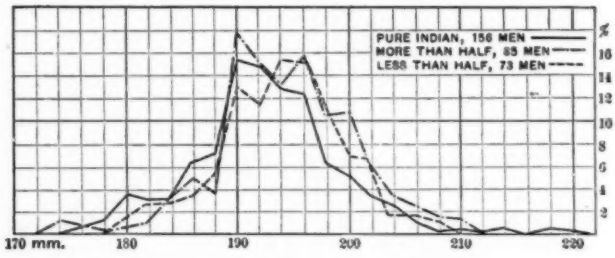

FIG. 11.—LENGTH OF HEAD. Eastern Ojibwas.

thus producing a much narrower nose. It appears at once that the nose of the half-blood man is not wider than that of the full-blood woman. The three-quarter bloods of the Ojibwas (Fig. 10) are found to take an intermediate position between full bloods and half bloods.

We will finally consider the effect of intermixture upon the length of head from the point between the eyebrows (the glabella) to the occiput among a tribe with a head that is shorter than that of the American white. The Ojibwa has a head which measures about 191 millimetres, while that of the white measures about 195 millimetres. A comparison of the three classes (Fig. 11) shows a gradual increase in length from the full blood, through the three-quarter blood, to the half blood.

We find, therefore, that the laws of heredity in the forms of the head and face are uniform, in so far as intermediate forms are produced. I presume, however, that in all these cases the middle forms are not found as frequently as forms resembling the two parental types.

WEST AFRICAN FOLKLORE.

By Colonel A. B. ELLIS.

UNTIL a few years ago it was popularly believed that the negro nations of West Africa were in the unique position of never having produced anything worth recording. They were supposed to have no history, no traditions, and no folklore, and even their religion was said to be something infinitely lower than was found anywhere else, a worship of sticks, stones, or shells, picked up at haphazard, and deified without rhyme or reason. This groveling religion, which was alleged to be significant of the degraded condition in which the West African negro was believed to be, was called fetichism, a word which, while really a corruption of the Portuguese *feitiço*, "amulet" or "charm," was supposed to be a negro word; and several treatises were written to show that, as it was impossible to conceive a lower form of religion, fetichism might therefore be assumed to be the beginning of all religion.

All these extraordinary beliefs, which had no foundation whatever in fact, may be traced to the reports made by those persons who, being engaged in the slave trade, resorted to West Africa in the seventeenth and eighteenth centuries. The great majority of these men had but a very transient acquaintance with West Africa, only remaining on the coast sufficiently long to obtain cargoes of slaves; and consequently it was impossible for them to have any real knowledge of the natives with whom they were brought in contact. Then, as they had no knowledge of African languages, they were dependent for their information upon those negroes who had acquired a smattering of some European language, and in most cases they seem to have completely misunderstood what their informants doubtless intended to convey. In other cases the slave-traders no doubt drew upon their imaginations, or exaggerated what they had seen; for if they could show that the negro was a mere brutish animal, they palliated to some extent the iniquity of the slave trade; and so his fancied brutishness was persistently brought to the front—at all events toward the end of the last century, when the traffic in slaves had begun to fall into disrepute.

Dr. Theodor Waitz, the distinguished author of Anthropologie der Naturvölker, was the first to express a doubt as to the authenticity of the supposed facts concerning the social condition and religion of the West African negro—which work my long acquaintance with West Africa has enabled me to continue, and in two volumes * I have shown that the religion of the negro, so far

* The Tshi-speaking Peoples of the Gold Coast and The Ewe-speaking Peoples of the Slave Coast.

from being fetichism, is a pure animism, or worship of spirits, differing in no important particular from that of other people on the same plane of civilization. In this paper I propose to dispel another illusion, and show that the negro, like all other races, has his folklore, or popular tales, which are in no wise inferior to those invented by other people. Of course, the Uncle Remus stories of Mr. Joel Chandler Harris are really American-negro versions of West African folklore tales, but in most cases the tales have been so much changed in order to adapt them to the altered conditions of life and the new *locale* that they can now scarcely be called examples of West African folklore.

It is among the Yoruba tribes of the Slave Coast that we find the folklore instinct most fully developed, and their tales may be numbered probably by hundreds. The itinerant story-teller, *akpalo kpatita* ("one who makes a trade of telling fables"), is a well-known character, who wanders from town to town, reciting tales. He is always well received, and is in great demand for social gatherings. He very frequently carries with him a drum, with the rhythm of which he fills up the pauses in the narrative. He strikes a few taps on the drum, to attract attention, and as soon as an audience is gathered he announces, "My *alo* * is about so-and-so," and then commences the recital.

The first and second of the following tales are Yoruba; the third is from the Ewe tribes, who inhabit the western portion of the Slave Coast, and among whom Dahomi is the one best known to Europeans; while the fourth is from the Tshi tribes of the Gold Coast, among whom are the Ashantis and Fantis. In each case the exact English equivalent of the native version has been given, and none of the stories have been in the least "touched up."

I. THE GOBLIN'S GIFT.

My *alo* is about a woman whose little girl made palm oil.†

One day, when she had made palm oil, she took it to the market to sell.

She stayed in the market selling her palm oil until it was quite dark. And when it was dark, a goblin ‡ came to her to buy palm oil, and paid her with cowries.#

When the little girl counted the cowries she found that there was one short. And she asked the goblin for the cowry that was wanting.

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* *Alo*, a tale, fable.

† Palm oil, which is made from the nut of the oil palm (*Elais guineensis*), is largely used in native cookery, and is one of the chief articles of commerce.

‡ *Iwin*, goblin, spirit, or ghost.

The cowry shell is the currency of the Slave Coast.

The goblin said that he had no more cowries, and the little girl began crying, "My mother will beat me if I go home with a cowry short."

The goblin walked away, and the little girl walked after him.

"Go away," said the goblin; "turn back, for no one can enter the country in which I live."

"No," said the little girl; "wherever you go, I will follow, until you pay me my cowry."

So the little girl followed, followed a long, long way, till they came to the country where the people stand on their heads in their mortars, and pound yams with their heads.*

Then they went on again a long way, till they came to a river of filth. And the goblin sang:

"O young palm-oil seller,
You must now turn back."

And the girl sang:

"Save I get my cowry,
I'll not leave your track."

Then the goblin sang again:

"O young palm-oil seller,
Soon will lead this track
To the bloody river,
Then you must turn back."

And she,

"I will not turn back."

And he,

"See yon gloomy forest."

And she,

"I will not turn back."

And he,

"See yon craggy mountain."

And she,

"I will not turn back;
Save I get my cowry,
I'll not leave your track."

Then they walked on again, a long, long way; and at last they arrived at the land of dead people.

The goblin gave the little girl some palm nuts with which to make palm oil, and said to her, "Eat the palm oil yourself, and give me the *ha-ha*." †

But when the palm oil was made the little girl gave it to the goblin and ate the *ha-ha* herself. And the goblin said, "Very well."

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* Yams are pounded into a sticky mass with a long wooden pestle, in a wooden mortar, hollowed out of a section of a trunk of a tree.

† *Ha-ha*, the stringy remnant of the pulp of the palm nut after the oil has been expressed.

By and by the goblin gave a banana to the little girl, and said, "Eat this banana, and give me the skin." But the little girl pealed the banana and gave it to the goblin, and ate the skin herself.

Then the goblin said to the little girl: "Go and pick three *ados*.* Do not pick the *ados* which cry, 'Pick me, pick me, pick me'; but pick those that say nothing, and then return to your home. When you are half-way back, break one *ado;* break another when you are at the house door, and the third when you are inside the house." And the little girl said, "Very well."

She picked the *ados* as she was told, and returned home.

When she was half-way home she broke one *ado*, and behold, many slaves and horses appeared and followed her.

When she was at the house door the little girl broke the second *ado*, and behold, many creatures appeared, sheep and goats and fowls, more than two hundred, and followed her.

Then, when she had entered the house, the little girl broke the last *ado*, and at once the house was filled to overflowing with cowries, which poured out of the doors and windows.

The mother of the little girl took twenty country cloths, twenty strings of valuable beads, twenty sheep and goats, and twenty fowls,† and went to make a present to the *iyale*.‡

The *iyale* asked whence all these things came, and when she had been told she refused to accept them. She said she would send her own child to do the same, and that she could easily get as much.#

Then the *iyale* made palm oil and gave it to her own little girl, and told her to go and sell it in the market.

The little girl went to the market. The goblin came, bought palm oil of her, and paid her with cowries. He gave the proper number of cowries, but the little girl hid one and pretended that he had not given her enough.

"What am I to do?" said the goblin. "I have no more cowries."

"Oh!" said the little girl, "I will follow you to your house, and then you can pay me." And the goblin said, "Very well."

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* The *ado* is a small calabash, commonly used for keeping medicinal powders in.

† The Yorubas reckon by scores and two hundreds—i. e., ten scores.

‡ In polygamous households the chief wife, who rules the others, is called the *iyale*, "mistress of the house." The mother of the little girl was one of the inferior wives, called *iya-wo*, "mistress of trade," because they usually sell in the markets.

From the European point of view this would appear to be a good trait on the part of the *iyale*, for the inference would be that she did not wish to deprive the subordinate wife of so much property, but that would not be the construction a native would put on it. To the native mind a person only refuses a present when he is nurturing rancor against the donor, and to refuse a gift is regarded as a sign of enmity.

Then the two walked together, and presently the goblin began singing, as he had done the first time. He sang:

"O young palm-oil seller,
You must now turn back."

And the little girl sang,

"I will not turn back."

And the goblin,

"You must leave the track."

And the girl,

"I will not turn back."

Then the goblin said, "Very well, come along." And they walked on till they reached the land of dead people.

The goblin gave the little girl some palm nuts and told her to make palm oil. He said, "When the palm oil is made, eat it yourself, and bring me the *ha-ha*." And the little girl ate the palm oil and brought the *ha-ha* to the goblin. And the goblin said, "Very well."

Then the goblin gave a banana to the little girl and told her to peel it. He said, "Eat the banana yourself, and bring me the skin." And the little girl ate the banana and carried the skin to the goblin.

Then the goblin said: "Go and pick three *ados*. Do not pick those which cry, 'Pick me, pick me, pick me,' but pick those which say nothing."

The little girl went. She found *ados* which said nothing, and she left them alone. She found others which cried, "Pick me, pick me, pick me," and she picked three of them.

Then the goblin said to her: "When you are half-way home, break one *ado;* when you are at the door, break another; and break the third when you are inside the house."

Half-way home the little girl broke one *ado*, and behold, numbers of lions and leopards and hyenas and snakes appeared. They ran after her, and harassed her, and bit her, till she reached the door of the house.

Then she broke the second *ado*, and behold more ferocious animals came upon her, and bit and tore her at the door.

The door was shut, and there was only a deaf man in the house. The little girl called to the deaf man to open the door, but he heard her not. And there, upon the threshold, the wild beasts killed the little girl.

II. THE MAIDEN WHO ALWAYS REFUSED.

My *alo* is about a beautiful maiden.

A man, his wife, and daughter lived in one house, in a certain town. And the girl grew up; she grew up very beautiful, and her father and mother were rich.

All the young men who saw her wanted her, and many of them sent presents to her father and mother, asking for her in marriage; but the maiden said she did not wish to marry.

So, whenever men came to ask for her, the maiden continued to refuse. She said, "My figure is good, my face is good, my skin is good,* therefore I shall not marry till I find a young man who pleases me."

So many young men came that at last the father and mother were tired of urging their daughter to marry, and they said to her: "Very well, choose for yourself; we will have nothing more to do with it."

And the maiden said: "Be not angry, O my father and O my mother! I am handsome, and I will only marry with one who is handsome. If I meet such a one in the town, I will make such and such signs to you when he walks with me to the door."

Now the leopard, living in his own place in the bush, heard this; and he turned himself into a handsome young man.†

He came into the town, and all the young girls turned their eyes after him, for he was good to look at, and he wore a silken cloth.

He walked through the town, holding in his hand a *duru*,‡ and he played on it a tune that was melancholy and sweet.

Now, just at this time the beautiful maiden had come out of her house, and as she walked along the street she saw the handsome young man playing on the *duru*. And the sounds of the tune he was playing went into her heart, and his appearance pleased her, and she loved him.

So she stood still in the street, looking upon the young man, who came nearer and nearer. And when the young man had reached her, he said, "Beautiful maiden, I am from a far country, to which the fame of your beauty has penetrated, and I have come hither to ask you to marry me, if you will so please."

And the maiden smiled and was glad. But she turned her eyes to the ground, and said to the young man: "O handsome stranger, is it the custom in your country thus to ask maidens to marry? My father and mother are here, near by, and with them lies the giving."

Then she led the way to the house of her parents, and the young man followed. And when she was at the door of the house she made the signs to her father and mother so that they might know that this was a young man whom she was willing to marry.

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* A smooth, glossy skin is considered a great beauty.

† In the Tshi variant of this story it is a python who personates a young man.

‡ The native guitar, called *sanku* on the Gold Coast. It has four, six, or eight strings, and is tuned in the diatonic minor scale, C, D, E flat, F, G, A, B, C.

The young man entered the house, still playing on his *duru*, and the sound of the music charmed the hearts of the old people, and his appearance pleased them, and they were glad.

And after greetings made, the young man said, "My father and my mother, I am from a far country, to which the fame of your daughter's beauty has penetrated, and I have come hither to ask you to give her to me in marriage."

And the old people said: "This, our daughter, has been many times asked in marriage, and has always refused;* therefore we said to her, 'Choose for yourself'; and now, if she says 'Yes,' we will not say 'No.'"

Then the young man took the maiden by the hand and looked into her eyes, and said, "Beautiful maiden, do you agree that we shall be married together?"

And the maiden smiled, but she turned her head to one side, and said softly, "Yes, handsome young man, I agree." And then she ran and hid in another room, for she felt bashful.

Then the young man thanked the old people, and he paid the head money and the head rum,† and gave many silk cloths for the bride, and the same evening they were married.

Next morning the young man said to the old people that he would now take his wife and return to his own country.

The old people felt sad at their child leaving them so soon, but they did not refuse. They gave her presents, and goats, and sheep, and fowls, and two female slaves, one that her father gave and one that her mother gave.

Then the father gave a word of advice to his child and the mother embraced her. They walked out on the road a little way with her, and then they turned back.

Then the young woman and her husband went on. They took a road that led into the forest, and the young man walked holding his wife's hand.

Then the husband led the way along a narrow and rough path, and the forest grew darker and denser, and the wife began to be afraid, for she saw she was going away from the cultivated lands into the haunts of wild beasts.

Presently, when they were in the thick wood, the husband said, "Wife, I am hungry."

And the young woman said: "How can I cook anything in

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* Parents can not compel a daughter to accept an unwelcome suitor, but if a girl persists in refusing eligible offers without sufficient reason they can, if they choose, refuse to maintain her any longer.

† Contracts of marriage are made by paying a certain sum, called "head money," and the payment of this sum is the only ceremony. "Head rum" is the term given to the refreshments which are provided for the marriage feast by the bridegroom.

this narrow place, husband? Wait at least until we reach the next village."

And the husband replied, "You need never cook for me, wife, for I eat my food raw."

Then the young woman was frightened, and began to have doubts about the man she had married. But she told the two slaves to put the calabashes down on the ground and asked her husband if he would eat some yam.

And he said, "I am not one who eats roots," and he took the fowls and ate them raw. He ate them all.

Then they went again along the path, farther into the forest, and presently the husband said again: "Wife, I am hungry. Is there anything to eat?"

The young woman was very much frightened; she did not know what to do, but she said, "Here are some sheep," and the husband took the sheep and ate them all up.

Then they went again on their way, and, after a little, the husband said, "Wife, I am hungry." And she said, "There are goats." And he took the goats and ate them.

After he had eaten the goats they went on once more, and soon the husband said again: "Wife, I am hungry. Give me something to eat."

And she said: "Is not everything finished? Have you not eaten the fowls and the sheep and the goats that my dear parents gave me? And now there is nothing more in my hand."

And he said, "All is not finished, for there are these two persons."

Then the young woman wept, she wept bitterly, and she cried, "Take them, then, and eat them, if it must be so."

Now, in order to bring down this flesh so that he might eat it, the husband had to turn himself back into a leopard. And he sprang upon the two slaves, and tore them and killed them, and ate them up.

When he had finished eating he again turned himself into a young man, and took his wife's hand and led her along the path. She wished to run away, but she did not know the way out of the forest, and fear had weakened her legs.

Presently the husband said again: "Wife, I am hungry. Give me something to eat."

Then the young woman threw herself on the ground and wept and lamented, for everything was finished, and there was nothing more to give him.

And the husband came and stood near her, looking sideways, and she was plump and soft, and he began to lick his lips.

Now, there was a hunter in the bush near by, and he heard

the lamentations of the young woman, and he crept up close and lay hid.

Then the husband said again, "I am hungry," and the wife sobbed and wept, but said nothing, for everything was finished.

Then the husband turned himself back into a leopard, and crouched down to spring upon her. He was just making a leap, when the hunter fired his gun, "Bang!" and he fell down. He was dead.

Then the hunter came out of the bushes. He spoke to the young woman and lifted her up. He cut off the tail of the leopard, and took the young woman to his house, where he made her his wife.

And this is the way of young maidens. The young men come to ask, and the young maidens refuse. They refuse again, again, and again, until at last the wild beasts turn themselves into men and come and carry them off.

III. WHY THE HARE HAS LONG EARS.

This is a story of the hare and the other animals.

The dry weather was parching up the earth into hardness. There was no dew, and even the denizens of the water suffered from thirst. Soon famine came, and the animals, having nothing to eat, assembled in council.

"What shall we do," said they, "to keep ourselves from dying of thirst?" And they deliberated a long time.

At last it was decided that each animal should cut off the tips of his ears and extract the fat from them. Then all the fat would be collected and sold, and with the money they would get for the fat they would buy a hoe and dig a well, so as to get some water.

And all cried: "It is well. Let us cut off the tips of our ears."

They did so, but when it came to the turn of the hare to cut off his ears he refused, and that is why his ears are so long.

The other animals were astonished at this conduct, but they said nothing. They took up the ear-tips, extracted the fat, went and sold all, and bought a hoe with the money.

They brought back the hoe and began to dig a well in the dry bed of a lagoon. "Ha! here is water at last. Now we can slake our thirst a little."

The hare was not there, but, when the sun was in the middle of the sky, he took a calabash and went toward the well.

As he walked along, the calabash dragged on the ground and made a great noise. It said: "Chan-gañ-gañ-gañ; chan-gañ-gañ-gañ!"*

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* The circumflex denotes a highly nasal sound.

The animals who were watching by the lagoon heard this noise and were frightened. They asked each other, "What is it?" Then, as the noise kept coming nearer, they ran away.

Reaching home, they said there was something terrible at the lagoon, that had put to flight the watchers by the well.

When all the animals by the lagoon had gone, the hare drew up water without interference. Then he went down into the well and bathed, so that the water was muddied.

When the next day came all the animals ran to take water, and they found it muddied.

"Oh!" they cried, "who has spoiled our well?"

Saying this, they went and got an image. They made bird-lime and smeared it over the image. Then they set it up by the well.

Then, when the sun was again in the middle of the sky, all the animals went and hid in the bush near the well.

The hare came. His calabash cried: "Chan-gañ-gañ-gañ; chan-gañ-gañ-gañ!" He approached the image. He never suspected that all the animals were hidden in the bush.

The hare saluted the image, but the image said nothing. He saluted again, and still the image said nothing.

"Take care," said the hare, "or I will give you a slap."

He gave a slap, and his right hand remained fixed in the bird-lime. He slapped with his left hand, and that remained fixed also.

"Oh! oh!" cried he, "let us kick with our feet."

He kicked with his feet. The feet remained fixed, and the hare could not get away.

Then the animals ran out of the bush and came to see the hare and his calabash.

"Shame, shame, O hare!" they cried together. "Did you not agree with us to cut off the tips of your ears, and when it came to your turn to do so, did you not refuse? What! you refused, and yet you come to muddy our water?"

They took whips, they fell upon the hare and they beat him. They beat him so that they nearly killed him.

"We ought to kill you, accursed hare!" they said. "But no—run."

They let him go, and the hare fled. Since then he does not leave the grass.

IV. LEGEND OF THE ORIGIN OF THE SARFU TOTEM CLAN.

There was a man of Chama* whose wife died. He buried her and mourned for her; and one day, in the evening, when he was

* Chama is a native town at the mouth of the river Prah.

walking along the beach toward the village of Aboanu, thinking about his dead wife, he met a strange young woman.

The young woman, who was very handsome, asked him why he walked alone and appeared so sad. He replied: "My wife is dead, and I am living alone. I feel lonely by myself, and there is no one to cook my meals."

The young woman said she felt sorry for him, and the two walked on, conversing together. She spoke kindly, and the man liked her appearance; so before long he asked her to take the place of the deceased, and come home and live with him. She agreed to the proposal, and, returning with the man to his house the same night, became his wife.

They lived together very happily for a time, but when three months had passed the wife grew restless and uneasy. Her husband asked her what was troubling her, but she put him off with excuses, until at last one day, when he had again asked her what was the matter, she said that she was uneasy in mind because she must leave him to go and visit her family.

The husband said, "That need not trouble you, for I will go with you"; but to this she would not consent, saying that alone she had come to him and alone she must go away.

Then the husband declared that he *would* go with her, and, as she still continued to refuse, he asked her to tell him her reason. For a long time she would not tell him, but at last he pressed her so much that she said, "I will not allow you to go with me, because you would laugh at me when we returned."

This answer much puzzled the husband. He asked, "Why should I laugh at you?" but she would not say why until he had sworn a great oath that he would never allude to what she was about to tell him. She then said: "You think I am a woman, but I am a fish. My family are fishes, and my home lies in the sea. If you still wish to accompany me, count the breakers as they fall upon the shore, and dive with me under the third one."

As the third breaker dashed upon the beach she threw herself under it, and, her husband following her, they both passed under the water, and arrived at the spot where her family dwelt. There the wife was joyfully received by her relations; she told her tale and introduced her companion as her husband.

The fish family made the man very welcome, and a house was put in order for him, outside which he was strictly enjoined not to venture; but they did not give him any reason for this.

The man complied with the request for some days, and then, one night, being tired of staying in the house, and seeing some young fishes at play, he went out to look at them more closely. He had scarcely left the house when all his wife's family came

round him, begging him to return, and, though he could not understand why they were so anxious, he returned.

Three days later, seeing the young fishes again at play, he a second time left the house to go and look at them. Now, since he had taken up his abode in the sea, he had acquired some of the peculiarities of fishes, among others the emission of a phosphorescent light by night; and, coming too near the surface of the water, he was seen by some fishermen in a canoe, who immediately speared him, thinking him to be an unusually fine fish. He cried out for help, and his wife's relations hastened to his assistance. They endeavored to drag him down to the bottom of the sea, but, finding that all their efforts were unavailing, and that the fishermen were still pulling him up, they begged a shark that was swimming by to bite through the fishing line that was fastened to the spear. The shark immediately complied, and the man was once more at liberty. He was taken back to the house, the spear was drawn out of his body, and by means of dressings which were applied the wound soon became healed.

This narrow escape had much frightened his wife's relations, and as soon as the man had recovered they told him that he could not stay there any longer, lest some other accident should befall him through his imprudence. Therefore they sent him back to the land with his wife, giving him as a parting gift the spear, which they specially charged him to keep carefully concealed.

When they returned to the shore the two went back to their former abode, and the man carefully hid the spear in the thatch of the roof. The house in which they lived formed one side of a central court, and other families lived in the houses on the three other sides. In one of these houses was the owner of the whole, and some years after the return of the husband and wife from the sea he determined to put new thatch on all the houses.

After he had got the grass all ready for rethatching, he began taking the thatch off the house in which the man and his fish wife lived, and had hardly taken off three armfuls before he discovered the spear, which the man had forgotten all about. Directly the house-owner saw the spear, he knew it by the marks on it, and said, "This is mine." He said that he had lost it one night when out fishing; that he had speared a large fish with it, which had broken the line and escaped. "How did you get it?" he asked the husband.

The husband pretended not to hear, but the house-owner repeated the question. Then the husband said he did not know the spear was there, but the house-owner said he did not believe him. He called him a thief, and said he would bring a palaver before the chief, because he had stolen the spear. Then the man was obliged to tell all to clear himself, and the house-owner was satis-

fied, and no more was said; but all the town now knew that the woman was a fish woman.

Nothing bad happened from this for some time, though the husband had broken his great oath never to mention that his wife and her family were fishes; but one day a second wife whom the man had taken quarreled with the first wife—as wives will quarrel—and she taunted the first wife with being a fish, and laughed at her. The first wife was so much hurt at this that she made up her mind to go back to her family in the sea and become a fish once more. She went to her husband and said: "Twice have you done wrong: first, in refusing to let me go alone to visit my family; and secondly, in breaking your great oath and revealing my secret, which you swore to keep. I can no longer live in a place where I and my children will be laughed at and put to shame. I will return to my home."

Her husband endeavored to pacify her, but in vain, for she would not be pacified. He said he would send away the second wife, but still she was not satisfied. He begged and entreated her to stop, but it was all of no use. Then he tried to hold her and keep her by force, but she broke away from him, and running down to the seashore, called to him a last good-by, and plunged into the sea with her youngest child in her arms. After that she was never seen again. Her two elder children remained with their father, and from them is descended the *Sarfu-ni-nam* * clan, none of whom may ever eat *sarfu*, for the fish woman was, when in the sea, a fish of that kind.

FAR from finding fault with the mistakes in science which we observe in the works of the early Christian exegetists, the Rev. John A. Zahm, of the University of Notre Dame, maintains that "we should rather be surprised that the errors are so few. They were certainly not more numerous, nor more serious, than those found in the works of the ablest of the professional exponents of the profane science of the period. It were foolish to expect them to know more about geography than Eratosthenes and Strabo and Pomponius Mela, who had made a life study of the subject; or to demand of them a more accurate knowledge of astronomy than was possessed by Hipparchus or Ptolemy; or to suppose that they should have a more precise and a more extended acquaintance with physics and natural history than had Aristotle or Pliny. Such an exaction would be the height of unreason. As well might we find fault with them for not being so well versed in physics as Ampère or Maxwell, or reproach them for knowing less of astronomy than Leverrier or Father Secchi, and less of geography than Humboldt, Malte-Brun, or Carl Ritter—men whose science was based on the experiments and observations of thousands of investigators, and on the accumulated knowledge of well-nigh twenty centuries."

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* *Sarfu-ni-nam*, "No sarfu flesh"; literally, "Not to have sarfu flesh." The *sarfu* is a kind of horse mackerel.

BARBERRIES: A STUDY OF USES AND ORIGINS.

By FREDERICK LE ROY SARGENT.

II.

WHILE the vegetative organs of barberries exhibit, as we have seen, an abundant variety of form and many degrees of differentiation, the reproductive organs are, on the contrary, so very similar throughout the group that what we may find to be true of a single example, such as *Berberis vulgaris*, will apply very generally to all the other species.

In the flowers (Figs. 2 and 3) there is traceable in almost every feature some relation to the visits of insects. Thus the conspicuousness gained by the yellow color * of every part, enhanced by the clustering of the flowers and supplemented by their sweet perfumes † attractively advertise, the abundant nectar which visitors find provided for them through the activity of the twelve orange glands (Fig. 3, N). In time of rain these sweets are protected by the pendent or nodding attitude of the flowers. On the arrival of an insect the movements by which it obtains a sip of the nectar are turned to account in a way to secure an advantageous transfer of the pollen from anther to stigma.

It has long been known that the stamens are so sensitive that at the slightest touch on the filament there is a quick inward bending of the organ which brings the anther with its exposed pollen to the center of the flower. Subsequently the stamen regains its original position, and will now respond to another touch as before. Sprengel in whose classic work ‡ were first revealed some of Nature's most cherished secrets, considered this to be an arrangement whereby insect visitors brought about the self-pollination of the flower, thus making possible the setting of seeds. But later experiments have shown that while Sprengel was entirely right in supposing insect visits to be of the utmost importance in securing fertilization, nevertheless the barberry is no exception to the general rule announced by Darwin, that flowers which attract insects gain from their visits the advantages which come from the transference of the pollen of one flower

* As berberine is reported to occur in the flowers (Huseman u. Hilger, Pflanzenstoffe), their color may be considered as due at least in part to the same pigment which is present in the wood and bark.

† According to Kerner (Pflanzenleben, ii, p. 195) this odor is essentially the same as that of white hawthorn flowers, which is known to arise from the presence of trimethylamine—a substance widely distributed in Nature, and curiously enough the cause of the characteristic odor of herring brine.

‡ Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen. Berlin, 1793.

to the stigma of another, the result of such cross-pollination being greater vigor in the offspring. Thus Prof. Halsted * found that barberry flowers from which insects had been carefully excluded produced no fruit (others uncovered on neighboring branches fruiting abundantly), and this in spite of the fact that through jarring or as a result of age the stamens had curved inward as far as they ever could. Microscopical examination showed a considerable quantity of pollen to have been deposited among the viscid hairs which form a ring about the top of the pistil (see Fig. 3, H), but none whatever upon the cushion-like summit which was found to be the only part that served as stigma.

Barberry blossoms are great favorites among the insects. Few of our June flowers gather about them a larger number of bees, hornets, flies, butterflies, and beetles. The smaller bees and certain flies are especially abundant.

There is some reason to believe that the intense color of the glands may serve as a guide to the insect, directing it at once without loss of time to the nectar which collects in little hollows between the bases of the filaments and the glands, where it is held by capillary attraction. An insect in thrusting its proboscis into a nectar cavity must touch the base of two filaments, whereupon both stamens suddenly bend inward and strike the insect's head. Now, Müller † calls attention to the fact that while large insects such as bumblebees pay no attention to this, but continue to make the circuit of the flower, smaller ones, like the hive bee, appear to be somewhat startled by this performance and fly away at once to another barberry flower. But the insect carries with it some pollen upon one side of its head, and if in the next flower this comes into the same relative position as before, more pollen will be added on the same part; but if, on the other hand, the flower is approached from the other side, then the pollen already collected will be deposited upon the stigma, while at the same time a new supply of pollen is being received which may in turn be carried to still another flower. As the smaller insects are the more common visitors, cross-pollination, which is so much the best for offspring, must therefore be the most usual result.

This sensitiveness of the stamens is exhibited by all the species of *Berberis* so far as known, but is not found in other members of the family, although a somewhat similar irritability of stamens has been observed in certain of the *Portulacaceæ*, *Tiliaceæ*, *Cistaceæ*, and *Compositæ*. The strikingly animal-like nature of the movement is well shown by the following facts: A chemical stimulus, such as ammonia gas, will induce contraction as effectually as a mechanical stimulus. The presence of oxygen

* Botanical Gazette, August, 1887, p. 201.

† The Fertilization of Flowers, p. 91.

and a suitable temperature are necessary conditions. Repeated stimulation at short intervals fatigues the organ, making it less and less responsive, until finally all signs of sensitiveness disappear, to return only after a period of rest. Certain chemical substances which are known to abolish or suspend the contractility of animal protoplasm have been found to affect in a corresponding manner the movements of barberry stamens. Thus nicotine, alcohol, and the mineral acids destroy all power of movement. A one-per-cent solution of morphine is similarly active, while curare, the powerful nerve poison which leaves the contractility of muscle unaffected, is found to exert no influence upon the stamens of *Berberis*. The effect of arsenic and corrosive sublimate is to render the filaments rigid and brittle, while if poisoned with prussic acid or belladonna they become relaxed and flaccid. By exposure for a short time to the vapor of chloroform or ether the

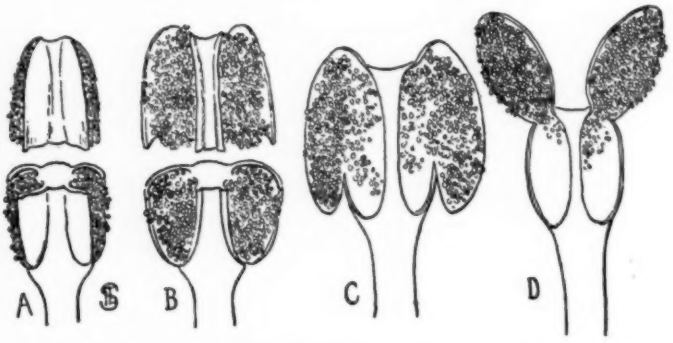

FIG. 13.—Series of anthers connecting the primitive form with that having valvular dehiscence: A, *Podophyllum emodi;* B, *Podophyllum peltatum;* C, hypothetical transition form; D, the barberry form. All somewhat diagrammatic.

power of movement is suspended, but may return after removal from the influence of the anæsthetic.

Moreover, experiment shows that the part of the filament which contracts is not necessarily the part touched—that is to say, there is a transmission of stimulus from cell to cell. So long as it was believed that the contents of neighboring plant cells were always completely separated by an imperforate wall, no satisfactory explanation could be given of such a transference of impulse, but now that modern microscopy has revealed the presence of protoplasmic threads passing through the cellulose walls of sensitive tissue, making the living matter continuous, the phenomenon in question may be understood as a manifestation of that fundamental property of protoplasm, irritability, to which we also refer the sensitiveness of animals, even though it be exhibited in a highly differentiated nervous system.

Since the irritability of the stamens is found so commonly

throughout the genus, we may assume the ancestral herbaceous barberry to have had the same peculiarity, but how this remarkable degree of sensitiveness could have arisen is not so clear. It would seem as if insect agency in some way or other must have brought about a movement having such an obviously purposeful relation to insect visits; but when we reflect upon the almost universal absence of a similar movement in flowers similarly visited, and the very questionable usefulness of the pronounced irritability of "sensitive" leaves, it is apparent that such a simple general explanation really explains very little. The few conjectures that the writer has to offer on the subject will be best understood after we have considered what may probably have been the evolution of certain structural peculiarities of the flower.

The anthers (Fig. 3, A), opening as they do by little valves hinged at the top, present a form of dehiscence confined entirely to the *Berberidaceæ*, the *Lauraceæ*, and a few other nearly related families not represented in our native flora. Within the *Berberidaceæ* all the genera except *Podophyllum* (the May apples) and *Nandina* have the anthers thus characterized; hence, it is clear that the stamens of the ancestral berberis were already of this peculiar type, and so the antecedent stages should be thought of as occurring in that line of berberidaceous herbs which were the forerunners of the barberries. The herbaceous genus *Podophyllum* contains species exhibiting a difference in the stamens which affords us an important clew for the understanding of what these antecedent stages may have been like. In *P. Emodi* (Fig. 13, A) the dehiscence of the anthers is by a longitudinal slit down the middle of each lobe. In *P. peltatum* (B), our common species, there is likewise a vertical slit, but it is so near the inner side of the connective that there appears to be but one valve to each lobe, the other inner valve having been reduced to a mere vestige. To connect this condition with that common elsewhere in the family, we need only suppose the attachment of the enlarged valve to become gradually narrowed by a continuation of the slit from below (C) until there remains only the small hinge we find in the barberry stamens of to-day (D). It deserves notice that the hinge, instead of being quite at the top, is nearer the back of the anther, which is what might be expected according to the hypothesis.

In the other families we have mentioned as exhibiting a valvular dehiscence of the anthers there is found almost invariably a pair of nectar glands on each filament (see Fig. 15). Now, it is a curious fact that in certain of the less highly developed mahonias the filaments are each provided with a pair of appendages (Fig. 14, A) similarly placed but being, so far as we know,

quite as functionless as are the cilia on the leaf margin of our common barberry. These cilia we saw good reason for believing to be rudimentary spines. The supposition that the stamen appendages are degenerate nectar glands would seem to be scarcely less probable, in spite of our inability to find as full a series of intermediate stages. For it should be remembered that the time

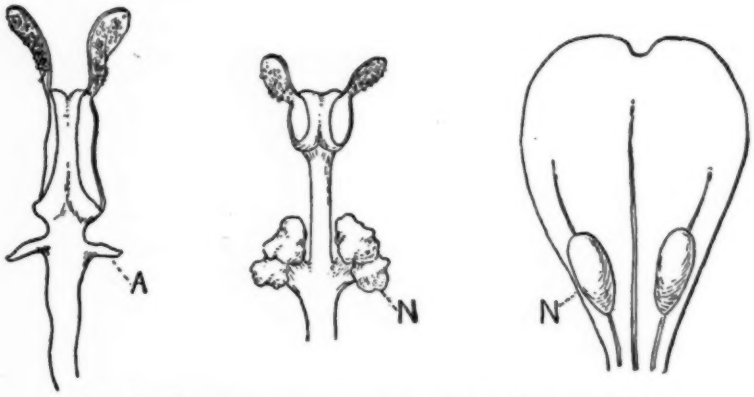

FIG. 14.—BERBERIS AQUIFOLIUM. Stamen showing appendages (A).
FIG. 15.—LINDERA BENZOIN. Stamen showing nectar glands (N).
FIG. 16.—BERBERIS VULGARIS. Petal showing nectar glands (N).

which has elapsed since the development of the floral peculiarities here considered is surely much greater than in the case of the foliar modifications, and consequently it would be strange indeed if the intermediate stages had not disappeared.

Although, in regard to the evolution of the floral organs, there is so much less opportunity than with the vegetative system to test the validity of our conjectures, yet it may not be entirely profitless to follow such clews as are available, and endeavor to reconstruct hypothetically the main features of those more primitive flowers from which the present barberry type was derived.

A multitude of stamens and pistils is generally recognized as characteristic of primitive flowers;* hence, we shall probably be not far wrong in considering the remote ancestor of the barberries and their kin to be in this regard very like a marsh marigold (*Caltha*), although doubtless less conspicuous, and with the parts more definitely arranged. As it is a very general characteristic of berberidaceous flowers that the parts are in whorls of three, we should expect this to be the case with the common ancestor. Accordingly, we arrive at a generalized type of flower, the structure of which may be expressed diagrammatically as in

* In the *Lardizabalaceæ*, an exotic group which some botanists consider to be a subfamily of *Berberidaceæ*, the pistils are from three to nine in number.

Fig. 17. At this stage we should also expect the flowers to be solitary, arising each from the axil of a leaf very similar to the rest of the plant's foliage.

Competition in securing the benefits of insect visits, together with the possibilities of a more economical as well as more effective disposition of tissue-building material, would conspire to bring about through natural selection the following changes:

1. Those branches of the herb on which flowers appeared would be given up more and more fully to their function of flower production; their subtending leaves would be reduced in size, and through a shortening of the axis the flowers would be brought closer together, and thus their conspicuousness enhanced. At the same time, part of the material saved might go to form additional flowers in the cluster. With the assumption of the shrubby habit the floral branches (peduncle, rhachis, and pedicels) retaining their herbaceous nature, in consequence of their short-lived usefulness, would appear still less like the others. The formation of flower buds to last over the winter would favor the blossoming of the flowers more nearly together in the follow-

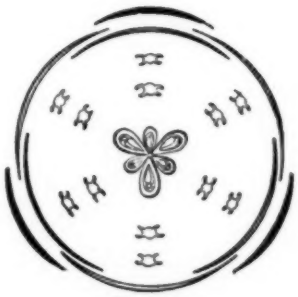

Fig. 17.

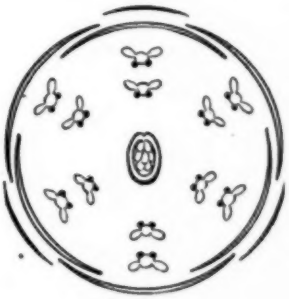

Fig. 18.

Fig. 17.—Diagram showing number and arrangement of parts in the primitive berberidaceous flower. Bracts, three (heavy black); sepals, six (outlined); stamens, twelve, dehiscence longitudinal; carpels, six, many-ovuled.

Fig. 18.—Diagram of flower (hypothetical) in a stage of evolution intermediate between the primitive form and the highest barberry type. Bracts and sepals as before; stamens, twelve, with valvular dehiscence and bearing nectar glands (heavy black); carpel, one, many-ovuled.

ing year. As the subtending leaves would now have lost almost the last vestige of their usefulness, we should expect their reduction to mere scales. The result of all this would be such a raceme as we find the barberry to possess (Fig. 2).

2. With the increase in the number of flowers in a cluster there would be less need for so many pistils in each flower. It might often happen that only a few of those in one flower would be fertilized, and in that case the store of food could be increased in the favored seeds, much to the advantage of the offspring produced. Pistils which ceased to have a use would gradually dis-

appear, until finally there would remain a single one of much increased serviceableness (Figs. 18 and 19).

3. For the reasons already given we may suppose the stamens to have their anthers so modified as to open by hinged valves,* while at the same time there was developed upon each filament a pair of nectar glands (Fig. 18). Insect visitors, finding an abundance of nectar in a flower, would be less likely to feed upon the pollen, which is so precious to the plant. As the position of the nectar is nearer the center of the flower, the visitor comes to occupy a more definite place relative to the pistil and stamens. The six stamens of the inner row are for the most part the only ones which can have their anthers touched, for, as will be seen from the diagram, the remainder are so placed as to be directly behind the others. Being thus superfluous as pollen-producers, the anthers of the other stamens would naturally degenerate, and if they follow the general rule of stamens in flowers which are provided with an abundance of building material (as, for example, the "double" flowers of the florists), they would change into something very like petals. If these petaloid organs became slightly arched over the inner stamens, they might still be of use in the floral household by giving better protection to the pollen than it had previously had, and at the same time increase somewhat the conspicuousness of the blossom. While it is by no means clear that any advantage is gained by having such an organ bilobed at the upper end, it might be a not unnatural result of that special part's having been derived from a bilobed anther. A glance at Figs. 3 and 16 will show that just such a petaloid organ is situated behind each of the stamens in a barberry flower.†

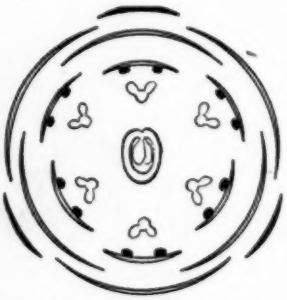

FIG. 19.—Diagram of euberberis flower. Bracts and sepals as before; petals, six, with nectar glands; stamens, six, with valves but no glands; carpel, one; ovules, few.

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* If it be supposed that the flowers were originally erect, it is possible that this peculiar modification of the dehiscence may have arisen as a protection against rain, which would thus be hindered from washing away the pollen, or indeed quite prevented from so doing if the valve could have had that power of closing in wet weather and opening in dry which Kerner ascribes (Pflanzenleben, p. 123) to the anther valves of certain *Lauraceæ*. At the present day, as we have seen, the barberry stamens are so well shielded from the rain by the pendent attitude of the flowers that any such peculiarities of the anthers can hardly be of much service in this particular. Still, the assumption that this was equally true in the ancestral forms is of course unwarranted.

† In *B. vulgaris* it is the rule for these petals to be entire, its near relative, *B. canadensis*, having them bilobed. Fig. 3 and also Fig. 16 were, however, drawn directly from undoubted specimens of *B. vulgaris*.

The nectar glands of these hypothetical outer stamens, although situated behind the others, would not be disqualified in the least by such a position from continuing to perform their function. On the contrary, it might well happen that, as they no longer produced pollen, they would secrete all the more nectar in consequence, and thus relieve the inner stamens of so much of their work. No longer required, the glandular appendages of the latter would be reduced to rudiments (as in mahonias), or entirely disappear, as we have seen in the case of the true barberries.

Do the above considerations help us to any better understanding of how the irritability of the stamens came to be developed? In our previous consideration of this remarkable property, we saw reason to believe that such a peculiar manifestation of protoplasmic activity could only be satisfactorily explained as having resulted from a rare combination of favoring circumstances. Although, in the discussion of such a matter, we are confessedly treading upon uncertain ground, still, it may be worth while to inquire whether, supposing the barberry flower to have been evolved essentially after the manner indicated, there have not been thus happily combined the very factors we should deem necessary and adequate to produce this result. It should be remembered that we are not endeavoring to account for that fundamental property of protoplasm known as contractility, but only for its being in the stamens of the barberry so much more strikingly exhibited than in other organs of the plant, and in the great majority of other plants.

In the first place, in order that this or any other property of protoplasm should be especially well shown in any organ, it would seem to be a prerequisite that the organ should be unusually rich in protoplasm—a supposition which is confirmed by the comparative study of motile organs. Such a very considerable reduction of parts as we believe to have taken place in the barberry flower might well be connected with the enrichment of the remaining tissues.

Secondly, a mechanical stimulus applied repeatedly for innumerable generations, at a very definite part of the stamen, would seem to be also necessary in order to account for the fact that movement of the organ occurs in response to a touch only when applied to the front of the filament and near its base. From the position which the glands came to occupy in the flower, just such a stimulus was afforded by the proboscis of every insect that sipped the nectar.

Whether we are at liberty to suppose that the direct effects of such a repetition of stimuli may be accumulated through inheritance, or whether we must assume only the inheritance of fortuitous variations, is of comparatively small consequence in this

particular case, because the movement in question is undoubtedly useful, and as such, variations in this direction, be they fortuitous or mechanically induced, would be preserved by natural selection. In other words, an ever-recurring mechanical stimulus is presupposed even on the theory which works entirely with accidental variations, responding more or less fortunately thereto, while, if the stimulus be a direct cause of the favorable variations, its importance as a factor becomes still greater.*

Our theory of the origin of the peculiar movement in barberry stamens amounts, then, to this: Stimulation by contact at a definite part of the filament for innumerable generations, increase of the protoplasmic contents by the reduction of adjacent parts, and the usefulness of such a movement at every stage of its development—these three factors, although separately incompetent, have yet in combination been the ones chiefly concerned in bringing about through the agency of natural selection such changes in the protoplasm of the sensitive cells as make its fundamental property of contractility prominent to an extraordinary degree.

Fertilization being accomplished, the single pistil ripens into a berry. In *Berberis vulgaris* each of the two ovules ordinarily becomes a hard-coated seed flattened on its inner face by pressure (Fig. 20) in much the same way as happens with the two "beans" in a coffee berry. Sometimes (as in the so-called "male berry" coffee) one of the ovules aborts, thus leaving the other to form a seed proportionally richer in reserve food and correspondingly round in form. Occasionally there may be found barberry bushes producing fruit in which both ovules have aborted.† But according to Buckhout‡ such individuals "do not constitute a permanent variety, for stoneless barberries are only found on old plants, and it has been proved that young suckers taken from them and planted in fresh soil fruit with perfect seeds." Seed production in this case would thus seem to be a question of the plant's vigor at a given period, and so to be comparable with the case of ordi-

* The belief that stimuli of the sort described directly induce modifications which are inherited has of late years been advocated by Rev. George Henslow (The Origin of Floral Structures). But before this supposition can be accepted in the present case, we surely require an explanation of how it might be possible for changes induced in the protoplasm of the mature stamens of a given flower to exert a modifying effect on the pollen grains, or the female germ cells, for inheritance must, of course, proceed from them. The pollen grains being separate and distinct, and the female germ cells fully formed and presumably isolated from surrounding protoplasm at the time of the insect's visit, the difficulty suggested would seem to be a very serious one, and, so far as the writer is aware, not even a plausible explanation on this point has been offered.

† Sturtevant (On Seedless Fruits, Mem. Torr. Bot. Club, vol. ii, p. 3) cites a number of authors who have noticed this phenomenon in barberries.

‡ Treasury of Botany, vol. i, p. 136.

nary seedless varieties (such as bananas, navel oranges, and the tiny seedless grapes sold as dried "currants") only on the supposition that in the latter also there had been a loss of vigor through long-continued non-sexual propagation.

The agreeable tartness of the barberry fruit, which makes it so generally and so highly esteemed, is due to the presence of malic acid, a substance found also in the foliage. Besides being made into preserves and jellies, the ripe fruit is candied or may be dried like raisins. While yet green the berries are sometimes pickled as a substitute for capers. Barberry preserve is, moreover, often used as the basis of a refreshing summer drink —a sort of "barberryade." Finally, it is reported that in our Western States the fruit of *Berberis aquifolium* and certain other native species is made to yield upon fermentation an agreeable wine.

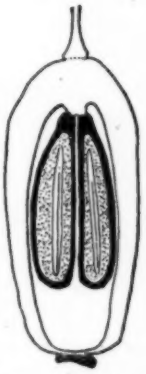

FIG. 20.—BERBERIS VULGARIS. Vertical section of berry, showing two seeds, each containing copious reserve food and a long, well-developed embryo.

But, for all their attractiveness to us, the berries seem to be less in favor with birds than are many fruits which we care nothing for. So long as the more succulent or less acid fruits are to be obtained, birds visit the barberry but little. When winter comes, however, they are glad enough to profit by the barberry's offer of something to eat, and the bright scarlet clusters do not dangle in vain.

Kerner fed certain thrushes with barberries, and found that the resistant seeds not only passed unharmed through the digestive tract, but their power of germination was improved, as shown by comparing them with seeds which had not been eaten. Add to this advantage the long distances which birds are likely to carry the seeds they eat, and the likelihood of their depositing them in most favorable situations, and it will at once be apparent how much superior to other methods is this mode of dissemination.

There can be little doubt that in the primitive ancestors of the barberry family the fruits were dry capsules which depended upon the wind to distribute their numerous seeds, as is the case to-day in the majority of herbaceous *Berberidaceæ*. That is to say, if we suppose the six pistils of the primitive berberidaceous flower (see Fig. 17) to have ripened into as many capsules, we shall have a form of fruit from which not improbably may have been derived all the different forms of fruit exhibited in modern representatives of the family. Confining our attention to the line which culminates in the barberry, it will be seen that the supposition of such a fruit's having descended from the primitive form above men-

tioned involves the assumption of the following changes: (1) The disappearance of all but one of the pistils; (2) reduction of the number of seeds; (3) the abandonment of dehiscence; (4) increased hardness of seed coat; (5) the acquirement of succulence; (6) the development of an attractive color.

The first-named alteration we have already considered in connection with the evolution of the flower. As with this, so with the other changes, the best we can do is to imagine how they might have come about. Now, it is true of all capsular fruits that until fully ripe they are neither dry nor dehiscent. We know that variations in the time of ripening do occur, and experiments have shown* that even unripe seeds will germinate and produce strong, healthy plants. In view of these facts it seems reasonable to suppose that not only might there arise varieties in which the capsule would retain something of its succulence until the seeds were nearly ripe, but if the fruit in this condition were eaten by birds or other animals the seeds might be disseminated by them, much to the benefit of the favored variety. There were doubtless seasons of scarcity in prehistoric times as well as now, when animals would be glad of even such comparatively unattractive fruits as we have described. Among the descendants of those plants whose fruits had become somewhat berrylike, those having the more succulent pericarp would, other things being equal, have most descendants, and thus in the course of many generations the present condition be reached.

The conspicuousness, depending as it does upon the same changes in the original pigment as occur in the transformations of chlorophyll in autumn leaves, may be looked upon as a result incidentally connected with the retention of succulence in the pericarp after growth had ceased, and as this tendency for the fruit to assume a color contrasting with the foliage would be beneficial as an advertisement to birds, natural selection would favor rather than hinder it.

The fact that in mahonias the berries are commonly of a dark purplish blue suggests that possibly this was the color first assumed by the fruit of the genus, the more conspicuous scarlet of the common barberry and its near relatives being acquired later, along with the higher differentiation of structure which it accompanies. Although this view gains some support from the occasional appearance of a blue-fruited variety of *Berberis vulgaris* (which might be thought of as a reversion to the ancestral type), still it should be remembered that our knowledge of the chemistry of plant pigments is at best too meager to justify much confidence in any theory of color change.

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* Goodale, Physiol. Bot., p. 460.

When once the good services of birds had been secured, there would be no need of having so many seeds in each fruit as must have been formerly necessary to compensate for the extreme wastefulness of wind as a distributing agent. At the same time a reduction in the number would permit, as we have already had occasion to notice, a higher development of each remaining seed—that is to say, an increase of reserve food and a thickening of the outer coat, features that we find to vary directly as the number of seeds, there being all the way from eight (in many mahonias) to two or even one in the true barberries.

However the characteristics of the barberry fruit may have arisen, the fact that they came to depend upon birds for their dissemination must have exerted an important influence upon all the subsequent differentiation of the group, for barberries were thus brought into widely separated regions which they might not otherwise have reached and so came to grow up in widely different surroundings.

We have already considered the extent of the migrations which are believed to have taken place in preglacial times. Among the forms which became adapted to the refrigerated climate that heralded the Glacial epoch, one of the most successful was probably a form almost if not quite identical with the modern *Berberis canadensis*, which despite its name does not grow in Canada, but is found only in the Alleghanies of Virginia and southward. Before the glacier came, however, the ancestral form we are speaking of probably did occur even to the north of Canada, and through the agency of birds was carried into Asia and distributed widely on that continent. Under the influence of their new environment it would not be strange if in the Asiatic descendants of the *canadensis* stock there appeared, even during the (geologically) short time since the beginning of the Glacial period, those slight differences which now distinguish *Berberis vulgaris* from the American descendants—differences which in the minds of some botanists entitle the two forms to rank only as varieties of the same species. After the retreat of the glacier, *Berberis vulgaris* extends into Europe to take the place of the mahonias previously exterminated. It now flourishes from England to Persia and from Persia to Japan. Our forefathers bring the plant to this country (largely for the sake of its fruit), and thus it finally returns to the ancestral acres. It would surely seem to be not a little invigorated by its journey around the world, since in the acquisition of American territory it appears to be in a fair way to outdo its stay-at-home relative, and has already fully justified with us its Old World name of "common barberry."

[*Concluded.*]

THE PROFESSIONAL TRAINING OF TEACHERS.

By M. V. O'SHEA.

ONE whose attention has been directed to the great activity which has taken hold of the modern educational world can not but have concluded that teaching has come to be regarded as a more or less difficult art, for which considerable preparation must be made in order that one shall be fitted to do it at all well. The present age has not been heir to such a view as this, however; for it has been comparatively recent that men have grown to consider the imparting of instruction successfully as an art to be acquired; they have looked upon it rather as an instinct that is born with its possessor, and that shows itself in some such spontaneous manner as do other characteristics and habits that lie outside of personal thought or control. The maxim that poets are "born, not made," has been applied with much vigor also to the great majority of teachers, who have themselves oftentimes not thought it necessary or expedient to make any definite preparation for their calling, other than to acquire a certain familiarity with the arithmetic or grammar or geography, knowledge of which they innocently hope to pour into their pupils' minds out of their own store of facts in these subjects. Educational practice of to-day, however, is not wholly in sympathy with the declaration that a teacher's art is born with him and can not be acquired; for it has provided elaborate means for the making of teachers, or at least for affording them opportunities to greatly improve upon what Nature has done for them. This has grown out of the belief that teaching is founded upon a science, and its successful practice must be acquired by special study and apprenticeship, just as with any other art, like civil engineering or architecture or medicine. Confidence in this opinion has spread widely throughout our own and other countries, and has resulted in the vast increase of means whereby every teacher may now have opportunity to become possessed in some measure of those special acquirements which, it is believed, are essential in order that he shall deal wisely with childhood in the schoolroom.

Previous to the eighteenth century there seems to have been no adequate conception of the training of mind as being amenable to the rules and methods of science. It was probably not thought that the mental life was subject to laws the nature of which could be ascertained, and which would have to be followed if there would be any success in leading the mind to attain those ends which should be kept constantly in view in all educational work. The teacher, then, would be successful according to the measure of his instinctive apprehension of the peculiar nature of each pu-

pil's mind; and there would not be much opportunity to increase his success by careful observation and study of a large number of children. The first recognition of teaching as an art, founded upon a rather indefinite science of the mind, seems to have been shown by the Jesuits in the seventeenth century, when they required every individual who should teach in their schools to spend two or three years as an apprentice, observing the ways of a master, who was supposed to have become familiar with the best art of teaching through his own experience in observation and experimentation. Later, Ratich urged that teaching was an art, and that those who were to practice it must become familiar with its rules and devices before trying it, lest those whom they should attempt to instruct should suffer by their ignorance and unskillfulness until experience should have taught them wisdom. In the eighteenth century Francke embodied this idea in his schools at Halle, requiring that all his teachers should, before being fully admitted to the profession, spend two or three years in observing others teach, and in reflecting upon the difficulties to be met with and devising means to overcome them. This was the forerunner of the "teacher's seminary," which has latterly spread throughout Germany and all the progressive countries of Europe; and which has crossed over the waters to our own land, where a different name has been taken, but where the same ends are aimed at. Previous to 1833 there were in France, according to Guizot, forty-seven primary normal schools, while at present there are one hundred and seventy-one well-equipped institutions, all of which have become governmental institutions. In 1827 David Stowe established the first normal seminary in Great Britain, at Glasgow; and such great popularity did this attain that other institutions of the same kind sprang up rapidly throughout Scotland and England, while training colleges and professorships of pedagogy in the universities have also been established. The first normal school in our own country began operations at Lexington, Mass., in 1829, and now there is not a State in the Union that has not several of these schools, supported at public expense; while normal colleges and professorships of pedagogy are meeting with favor and multiplying in all parts of the country.

In America there is a problem to be met in the training of teachers that gives very little trouble to many of the countries of the Old World. In Germany, Austria, France, and the other important nations of Europe, teaching has come to be regarded as a profession which, when an individual once enters, he rarely deserts, holding to it for life the same as if he had engaged in the practice of medicine or law. The population of these countries is practically constant, making it possible to determine pretty definitely about how many teachers will be required each year to

meet the demands of the public schools. On this account the teacher is reasonably certain of finding and holding a place in his profession if he enters it properly prepared; and the governments of these countries can say that no teacher shall engage in the practice of his profession until he shall have had the normal school or training-seminary preparation, which is provided free, under the provision that the beneficiary shall devote himself during his life, or a certain portion of it, to the work of teaching in the public institutions of the country. In our own country teaching is not yet regarded as a profession to any great extent; and a majority of those engaged in it do not continue in it for a long time, perhaps not more than two or three years. The greater number of teachers are women whose tenure of office in the schools is tentative, depending upon the time when they shall find more attractive life work; while most of the men who enlist under the banner of the schoolmaster do so only as preliminary to engaging in other and more remunerative professions when fortune favors. This uncertainty in things makes a thorough and systematic training of teachers in anything like completeness impossible in our own country at the present time. However, so thoroughly is it recognized by those familiar with the question that teaching is an art to be improved upon by special study, even by those possessing the most favorable endowments, that provisions are made for *some* professional training of every candidate for a place as master in the schools. This is done through teachers' institutes in all the States, summer schools, teachers' training classes in the high schools, normal schools, and departments and chairs of pedagogy in the universities; and by means of these agencies almost every teacher receives more or less professional instruction which enables her to grasp the problem she is to undertake in the management of a school in a more skilled and scientific manner. But, while not disparaging the work done by any and all of these agencies, it must still be said that it is to our normal schools that we must look for anything like that preparation and training which must be demanded of our teachers before our schools shall be able to realize adequately those ends for which they are established and maintained.

Something has been written against the normal-school idea by those who feel that the art of teaching successfully must spring up spontaneously out of the teacher's nature, since if it comes in any other way, through study and apprenticeship, it will be stilted, forced, and unnatural; and it is further urged that teachers who are thus made are more harmful than none at all. It has been held in some quarters that the normal school puts into the hands of its students a system of artificial makeshifts that prevent the outworking of individuality, and reduce all teach-

ing to mere mechanism and parrotlike imitation. "They make fine-working machines of our teachers," some still say, "but we would rather have spontaneous activity, even though ignorant and crude, than the finest action on the part of a machine." This criticism of the normal school has served a wholesome purpose in breaking up any tendency toward mechanism and spiritless, formal methods of teaching which might have been displayed in its earlier inception. It seems to be always true that in the beginning of any great institution like the normal school the letter and not the spirit will be at first emphasized; but in the process of healthy evolution the mechanical part becomes simply the means of expression of the principles and truths underlying. This has, no doubt, been true of the normal school; and, in its steady growth toward a more scientific basis for all it does, it has come to pass that at the present time its work in the training of teachers is made to cover the broadest and fullest possible view of the human being and the purpose of his education. It is recognized that the process of education from first to last is dependent upon laws of the human mind, and it is partly the province of the normal school to determine what those laws are. And further, when the aims and ends of education have been decided upon, the normal school must show what are the simplest, most speedy, and most certain ways of attaining those ends. If we look briefly at the work of the normal school as we have it now, we shall see that the charge of its being unduly mechanical and too feebly scientific can not be applied to it in its present stage of evolution.

The one ruling aim which gives character to the professional work in the normal school is the purpose to awaken in the teacher a consciousness that there is a science of education, and an art of teaching founded upon that science; to arouse in her an earnest, indefatigable ambition to become acquainted with the best in both, and, most important of all, to lead her to realize this in her own work. The distinguishing characteristic of professional instruction, which marks it off from purely academic study, is the attempt to acquaint students with the *teaching* aspect of subjects of instruction, and to lead them to become students of all the conditions in their schoolrooms that affect the action of the minds of pupils in responding to all the means of stimulation which the teacher consciously makes use of to attain the ends of development. In other words, it is aimed to make the teacher conscious of her art—conscious in the sense that she will intelligently consider the growing, developing mind, acting according to definite, exact laws; and that she will attempt to wisely use the agencies at her disposal in harmony with these laws to accomplish in the most ready manner the highest possible ends of school train-

ing. It appears, then, that the entire work in the professional training of teachers consists of an investigation into the laws and principles of mind activity, always followed by the effort to rightly adapt the means of stimulation in the schoolroom (the various subjects of instruction) to attain the full, harmonious, capable development of child-nature. In the normal school this work is usually divided into several branches, which, however, are very vitally related, and which are always arranged in the natural order of sequence. The following is, in general, a very brief outline of the work which is usually attempted in each branch:

I. PSYCHOLOGY.—The professional work is most naturally begun by reflection upon the nature of the mind to be educated, endeavoring to find those laws and principles according to which its normal activity is regulated in order that we may intelligently wield the means of stimulation to secure its most natural and speedy development. There are two methods which may be followed in this study: The first assumes that the mind is an inert object which can be abstracted from all concrete cases, and by an analytic process separated into its logical parts. As a result of this treatment we have a formal science of psychology, dealing with the powers and attributes of the so-called faculties of the mind, in the same way that we have a formal science of mathematics, physics, and so on, that treat of characteristic subject-matter in a logical way. The second method, which has come to be followed most largely now in our training schools, regards the mind as a growing, developing, assimilating power, and it is sought to become acquainted with it while under these natural conditions of activity. A knowledge of the mental life gained in this latter way will be very different from that acquired by purely formal study where the mind is considered apart from all concrete instances, and laws and principles are deduced which may be applicable to it in general, but which have no reference to the peculiar and distinguishing characteristics of specific instances, nor of the manifold modifying conditions under which all activity, as induced by educational agencies, occurs. It should be, and usually is, the aim to lead the prospective teacher to become somewhat familiar with the concrete and developing mind under those conditions which necessarily exist in all school work. It is generally true that those who seek the normal school have not the time nor the breadth of philosophical training and culture to enable them to make the study of formal psychology profitable, although it would be most valuable for one who could spend years in thought and reflection upon the matter, and who would not need to make practical application at once of the principles which he had considered. It is coming to be appreciated that while a teacher need not, in order to do most intelligent

work, be learned in the logical principles and divisions of mind activity, yet he does need to become acquainted with the action of the mind as it is manifested in the many concrete cases which are constantly before him in his daily work. He must come to feel that the mind acts according to law, definite, exact, and unerring, as well with reference to the subject-matter by which it is disciplined in the schools as to its reaction upon sense stimulus. He must be trained to observe the effect of all external conditions, bodily and otherwise, which do in any way modify or affect the mental and moral condition of the child; and it certainly can not be maintained that this study leads the teacher to become imitative and formal in his own class room.

Throughout all this work an effort is usually made to have the prospective teacher discover for himself the more obvious principles of mental activity, both by reflection upon the activities of his own mental life and by the observation of mind phenomena in the world about him. He is led to discern the intimate relation between body and mind, to discover for himself the law of mutual affection, and to trace the application of this fact in educational procedure. So it will be seen that the purpose is to initiate him into the habits of careful, intelligent observation of the facts of mental activity as displayed under the ordinary conditions of the class room, and to lead him to make correct, serviceable interpretations of what he observes. As an aid toward this, many normal schools include in their curricula special studies of child-nature in the concrete, in order to train teachers to habits of exact, scientific study of individual pupils under their charge, and also these individuals when they are combined into classes. The value of this work, when it is carried on intelligently, can not be overestimated; for it leads the teacher into those habits of trying to find some remediable cause for every undesirable manifestation of child-nature in the class room which constitute the most praiseworthy and serviceable attainments that those who deal with children can become possessed of. Such study is usually of great benefit to teachers by pointing out to them defects in vision and other physical imperfections in pupils, which render them incapable of the highest and best work which they could otherwise successfully undertake. The pupil teacher is made to realize that the environment of his own pupils will be a potent factor in determining the mental and moral effect which the means of stimulation in the school will have upon them; and he is further led to appreciate the maxim that in a great measure a teacher's success will depend upon his ability to perceive clearly the effect of external conditions, and to be able to arrange and modify them so that they will all operate toward the accomplishment of those ends which he is consciously seeking. It seems that such study as this

will bring the teacher into broadest sympathy with child-nature, and will enable him to affect peculiar natures and dispositions in such manner as to establish wholesome and desirable ways of action. It certainly is not true that the teacher is made a machine by work of this character; on the contrary, he is brought into the highest possible freedom by finding the truth in the objects with which he is to deal. How infinitely more free he becomes than when he remains the creature of his own ignorance and preconceived notions of the one formal way to deal with child-nature!

II. THE SCIENCE OF EDUCATION.—It has already been said that the study of psychology, for the teacher, must be of such character that he will be enabled to apply it practically in the daily work of instruction in the schoolroom; for so long as it remains merely theoretical he has received no benefit from it whatever, at least so far as he is professionally concerned. It follows readily, then, that the principles of the science of education must be gained simply as generalizations from the facts of psychology, viewed with reference to the conscious and scientific stimulation of the mind by educational agencies; and this is all that is attempted in this subject as the normal school has to deal with it. This study is but a continuation of the study of psychology from a special point of view—that of finding an order or method in education as determined by the facts which have been found in our observation of mind phenomena. It is continually emphasized in the normal school that all method in education is naturally and entirely dependent upon laws of mental growth and development. It is the purpose in this place to investigate the general principles which underlie all right educational procedure, with the end in view to lead the teacher to become conscious of the laws regulating the order both of the parts of the branches of instruction and of the branches themselves when they are considered with reference to training the mind; and it is believed that in this way he gains a knowledge of educational method and practice so wide and broad that there will be little danger of his mistaking the mechanism of school teaching, as exemplified by some individual who happens to be his instructor, for the true spirit as the body of it all. The ordinary student will not readily apply principles in which the concrete cases from which they are drawn are not clearly apparent; but in the consideration of such processes as induction, deduction, apperception, concentration, interest, attention, and so on, he will have no difficulty in seeing their universal application in all the work of instruction, especially if he is led to discover their importance by his own investigation.

There has been some objection on the part of certain philosophers to the proposition that there is or can be a science of edu-

cation. It is maintained that, on account of the changeableness of human life, the diversity of human nature, the varying ideals of educational practice, and so on, educational method must consequently be in a continual flux, with no certainty or definiteness about it. Perhaps all persons looking at a science of education from this point of view would agree that there must be a change of procedure to accommodate changing interests and ideals; but there is unanimity of opinion between educators and psychologists that the natural processes of the mind under stimulation by educational agencies do not vary for individuals or periods of time, or for theories as to the aims and ends of education. There is common agreement that the inductive process is the only one that the child mind can follow in getting its first knowledge of any branch of instruction, and this law must be universal. So, too, it is agreed that in every instance it is impossible to appropriate information of any character unless there is a swinging of the mind toward the object of which knowledge is to be gained, that is, unless there is an act of attention. And, again, it is coming to be realized more and more that there is a vital relation between the now many and varied branches of instruction—a relation which unites them so closely that the human mind grasps and appreciates them when presented together more naturally than when it tries to get them separately and disjointedly; and this also must be true for all time and all individuals. It is upon these and other uniform certainties that a science of education may be built, and there is no necessity to attempt to include within it all the uncertainties over which there seems to have been some worriment.

III. THE ART OF TEACHING.—When the teacher has become familiar with those general principles which must be observed in all the work of education, he is led to investigate the order and method in each of the various branches of instruction found in the schoolroom, to the end that he may present each one to the child-mind in a manner befitting its peculiar nature. From this study it will be found that the child acquires a knowledge of language and the use of it in a somewhat different way from that in which he masters the subject-matter of arithmetic and is able to use it as required. The apprentice teacher must come to understand and appreciate that the operation of the mind is not the same in gaining each and every subject which she uses in the schoolroom for its development; and this is often a great revelation to the novice, who little suspects that there is such diversity in things pedagogical. In this connection the student is made acquainted with those forms and devices for teaching each subject which best illustrate the psychological principles that have already been agreed upon. This work has been given the name of

"special methods," because it deals minutely with the principles of teaching each particular subject, and suggests also in some measure the mechanics that has been found adapted to each subject; and it is this latter kind of work that has brought more or less disrepute upon the normal school. But when a teacher is required to continue with this phase of his work until he is thoroughly able to comprehend that all devices and forms of teaching are but efforts of individuals to best illustrate the underlying principles, and when he is expected to work out a system of devices for himself before he leaves the school, then there is little danger of his falling into mechanical habits that will interfere with that spontaneity which is all-essential in spirited teaching. The normal school does not now emphasize the mechanical side of teaching as much as it did when the knowledge of psychology was so meager that pupil teachers could not hope to be investigators of the principles which underlie educational method, but must be content to be imitators of those who had made researches, and embodied these in an art which necessarily exhibited much of their own individuality. Every trained teacher is required in these times to study the mind of the child; and he is led to see that the whole realm of methods and devices must be built upon the laws of mental growth, and everything that has not this scientific basis is worthless and even injurious.

As a necessary part of this work in the art of teaching there is provision made in the normal school whereby theory may be illustrated in actual practice in the model, or practice, school. It is the aim in this school to show the application of principles and the proper use of devices by an abundance of illustrative teaching of such character that the apprentice may well emulate it in all respects. It has become a familiar truth that it is with teaching as with other callings in life—that in order to become able most speedily to do creditable work the candidate should have his attention specially directed to those qualities and accomplishments which mark successful teaching, because he will not, in all probability, appreciate them unless they are thus pointed out to him. It can not be too strongly emphasized that object lessons in successful teaching are as important and exemplify the same pedagogical doctrine as is the case in other departments of educational work. In this illustrative teaching the apprentice is required to analyze carefully and fully all the lessons which he observes, not only from the point of view of the essential principles underlying them, but he must take into account also the surrounding and accompanying conditions which materially affect the lesson favorably or unfavorably. Every student is trained to see and appreciate pedagogical problems, and he is expected to become able to point out an intelligent and practical way for their solution.

The practice department of the normal school usually illustrates a thoroughly graded and classified school from the kindergarten to the high school, and is designed to embody three phases of actual teaching: In the first place, as has been said, pupil teachers are expected to witness model teaching that exemplifies the very best psychological principles in order that they may have the very best ideals set before them. Second, every pupil teacher is required to teach for a certain length of time in this practice department under skilled criticism. The critic teacher, who is usually an experienced and competent person, is careful to point out the defects which the student displays in his practice work, and to give him explicit directions how to overcome them, always aiding him in every way possible to apply readily and efficiently the principles he has gained in his theoretical work. In the third place, there is usually a spirit of investigation found in these practice schools, seeking constantly to improve upon the methods of teaching which may be in vogue at any time; and, as a general thing, freedom is permitted the apprentice to work out original methods, provided these seem to be in harmony with the fundamental principles of teaching. It is not too much to say that it is the aim always to inculcate among pupil teachers that broad, wholesome spirit that will look upon the teaching profession as a high and honorable one, where more worthy motives should prevail than those of mercenary gain or social preferment.

IV. The History of Education.—In order that a teacher shall thoroughly understand and appreciate what is being done pedagogically in these times it is necessary that he be led to see how the present state of things has been brought about, in order that he may put himself in line with the ascending tide in educational practice. The history of education, as a record of the development of educational ideas and practices, showing the transition from a period of unpedagogical and unpsychological procedure to one with more humane and intelligent methods, is as stimulative and beneficial a study as a teacher can undertake. The aim generally kept in mind is to trace the process of developing pedagogical ideas with the end in view to see that there is and has been a constant evolution along several distinct lines of educational practice, and that we are at present in a stage of that evolution process which seems in no wise to be near completion. The apprentice is led to appreciate that there has been in educational history much the same awakening to the consciousness that there is a teaching science, determined by invariable laws of mind growth and development, as is experienced by the ordinary teacher who has come to look at her work from a psychological rather than an academic standpoint. An effort is made to have

the student trace the growth of progressive ideas through the different ages and combine this knowledge into one organic whole; instead of becoming possessed of a chaos of unrelated facts which may give general information, but can not be organized to afford intelligent direction to the efforts of the student who tries to meet the problems which confront him continually in his work. Surely there can be no broader study for the prospective teacher than to examine critically the great systems of pedagogical doctrine out of which our own has grown; such, for example, as those elaborated by Comenius, Rousseau, Basedow, Pestalozzi, Froebel, Herbart, Spencer, Mann, and others, and to profit by the successes and failures of these systems so far as they have been tried, and also to gain inspiration and courage from their exponents.

This in brief is what the normal school attempts to do for the professional betterment of those who seek its privileges. That there is great opportunity yet for growth every one admits; but no one who is in touch with the normal school will doubt that it is moving forward as rapidly as the law of growth of such an institution, conditioned as it is by the development of the school system as a whole of which it is a part, will admit; and that it is now filling a great mission (even with all its imperfections on its head) in improving the present condition of our schools, and pointing to higher and better things in the future, is amply shown on every side by the results of its efforts.

FUNERAL CUSTOMS OF THE WORLD.

By J. H. LONG.

A WRITER on the subject of the disposal of the bodies of the dead has said, "As there is almost nothing else so deeply interesting to the living as the disposal of those whom they have loved and lost, so there is perhaps nothing else so distinctive of the condition and character of a people as the method in which they treat their dead." It may be premised, then, that no custom stamps the standing of a people more clearly in the scale of civilization than does the care of the bodies of the departed. "People of a low and barbarous type carelessly permit the remains of the dead to lie in the way of the living, and there are a few instances in which the object of artificial arrangements has been to preserve a decorated portion of the body—as, for example, a gilded skull—among the survivors." The general tendency of mankind, however, has been to bury the dead out of the sight of the living; and various as the methods of accomplishing this end have been, they have resolved themselves into three

great divisions: (1) The simple closing up of the body in earth or stone; (2) the burning of the body and the entombing of the cinders; (3) the embalming of the body.

The first of these, i. e., the simple inclosing of the body in earth or stone, is not only the most widely diffused of the three, but also the earliest of which we have any record. It is referred to again and again in Scripture, although the other methods also are mentioned. A beautiful description of one of the most ancient of Bible burials is found in the twenty-third chapter of Genesis. It was considered by the Hebrews one of the greatest calamities and deepest marks of dishonor to be deprived of burial. So we read in the prophecy of Jeremiah against Jehoiakim, "He shall be buried with the burial of an ass, drawn and cast forth beyond the gates of Jerusalem." Evidently, next to the simple exposure of the body, which savored too much of cruel neglect, burial was the first means that would suggest itself to the human race for the disposal of the remains of the dead. In the beginning the rite was no doubt simple and unostentatious; but, as civilization advanced, it became more and more ornate, reaching in some lands and ages a pitch of ceremonial magnificence which seems incredible to us now, but relics of which are still seen in our modern funeral displays. There can be nothing more magnificent than the obsequies of a high dignitary of the Greek or the Roman Church. But still, to those outside these churches all such ceremonies appear just a little tawdry and garish. It is doubtful whether there is, or can be, any funeral ceremony so truly solemn as that which is held in Westminster Abbey. In such a burial there is everything calculated to evoke the most reverential, the most solemn thoughts—the dim religious light stealing through the painted windows far up against the sky; the long vista of arch and pillar and tomb; the silence, broken only by the solemn service for the dead, the deep roll of the organ, and the voices of the singers like the singing of angels far away; more than all else, the thought that everywhere about us lies the dust of those who once filled the world with their fame, from the days of St. Edward the founder, yes, from the days of Sebert the Saxon king. A burial at Westminster marks the highest point ever reached by this form of sepulture. It stands at one end of the series. At the other end stand those hideous rites which have been practiced in many a heathen land: in Ashantee, in Dahomey, in ancient Mexico, in certain of the south sea islands, and (formerly) in India. Let me epitomize two or three extracts bearing on this: "Herodotus tells us that when a king died in ancient Scythia, those who attended him cut off one ear, shaved their heads, wounded themselves on the arm, forehead, and nose, and pierced the left

hand with an arrow. Furthermore, the undertakers or managers of the royal funeral had to furnish a woman, a cup-bearer, a cook, a waiter, a messenger, and a certain number of horses; all to be killed. In fact, in the particular king's funeral which the great Greek historian is describing they took the king's ministers, fifty in number, and strangled them. Then, having killed fifty of the chief horses of the king, they prepared them and set them in a circle, upon each one a strangled rider, that they might serve as a royal guard to the dead hero." "The chiefs of the Fiji Islands have from fifty to one hundred wives, according to their rank. At the interment of a principal chief the body is laid in state upon a spacious lawn in the presence of an immense concourse of spectators. The principal wife, after the utmost ingenuity of the natives has been exercised in adorning her person, then walks out and takes her seat near the body of her husband. A rope is passed round her neck, which eight or ten powerful men pull, until she is strangled and dies. Her body is then laid by that of the chief. In this manner four wives are sacrificed, and all of them are interred in a common grave, one above, one below, and one on either side of the husband. This is done that the spirit of the chief be not lonely in its passage to the invisible world, and that, by such an offering, its happiness may be at once secured." It may be added to this that, in certain lands, the custom is to inter *alive* the attendants of the dead chieftain; it being believed that this precaution adds to the solemnity of the occasion and to the future happiness of the departed. In ancient Mexico this practice of sacrificing upon the occasion of a funeral was carried on with great pomp and lavish effusion of blood, in some cases a hundred persons being slain to act as guides and servitors to the deceased chief in his journey to the other world. In India, owing to the kindly offices of the British Government, the terrible suttee has entirely disappeared. This, it is needless to say, was the custom of self-sacrifice by the wife of the dead husband. It is impossible not to admire the heroic spirit of those Hindoo widows who deemed it a high honor to cast themselves upon the funeral pyre of their spouse. "Indeed, when the female slaves find their mistress is greatly afflicted at the loss of her husband, they promise her, in case she is resolved not to survive him, to burn themselves along with her, and are always as good as their word. They dance near the funeral pyre, and throw themselves into it, one after another."

The two other modes of sepulture are, as has been said, embalming and cremation. Embalming was not unknown among the ancient Hebrews: there is frequent allusion in the later Scriptures, and especially in the New Testament, to the embalming of the body in antiseptics and fragrant substances. But the land

which was distinctively the land of embalming was Egypt. This subject is so vast that it is possible to refer to but two or three points. One is the peculiar custom of judging the dead, before a monument might be erected or other honor paid to their memory. A writer on this subject says: "The judges who were to examine into the merits of the deceased met on the opposite sides of a lake. . . . When the judges met, all those who had anything to object against the deceased person were heard; and, if it appeared that he had been a wicked person, then his name was condemned to perpetual infamy, nor could his dearest relatives erect any monument to perpetuate his memory. This made a lasting impression upon the minds of the people, for nothing operates more strongly than the fear of shame and the consideration of our deceased relatives being consigned to infamy hereafter. Kings themselves were not exempted from this inquiry; all their actions were canvassed at large by the judges, and the same impartial decision took place as if it had been upon the meanest of the subjects." This trial, which is described in the Book of the Dead, was a foreshadowing of the trial of the soul by Osiris and his brother judges, before it might be received into the Elysian Fields or the Pools of Perfect Peace. The requirements for passing this latter ordeal were very much the same as those set forth in the Sermon on the Mount: to care for the fatherless and the widow; to give food to the hungry, drink to the thirsty, clothes to the naked, oil to the wounded, and burial to the dead; to be faithful to the king, and loving to wife and child.

Another point deserving of notice was the strange custom of placing the mummy in the seat of honor in the banquet hall. This had a twofold office: (1) To warn the living of the fate in store for them, like the *memento mori* of the Romans; (2) to show honor to ancestors. So it came to pass that of all lands in the world, Egypt—so rich in obelisk and pyramid and needle; Egypt, whose air does not destroy, but preserves—is also the richest in these mute memorials of the once-living dead. What a marvelous thing it is that we may to-day gaze upon the very face and form of the Pharaoh who would not let Israel go, of him who built the treasure cities of the plain!

The third method of disposing of the dead is by burning—cremation, as it is now called. Many nations have practiced burning, the best instances being the Greeks and the Romans. Among the Greeks both methods were employed—burning and burying; but gradually burning came to be the popular mode, the reason being that fire was supposed to purify the celestial part of man by separating it from the defilements of the body, and thus enabling it to wing its flight to purer realms. More than the Greeks the Romans were devoted to the process of cremation, al-

though in early ages they buried their dead. Cremation became general at the end of the republic, i. e., shortly before the birth of Christ. Under the emperors it was almost universal, but it gradually disappeared as Christianity gained sway. The Roman burial rites were very rigorous and voluminous. The ceremonial of a modern funeral is as nothing compared with the Roman ceremonial. There were the musicians, the players, the imitator (who personated the dead), the images of the deceased, the train of slaves and freedmen, the relatives tearing their garments and covering themselves with dust, the funeral oration, and the final obsequies at the pyre. This pyre was built in the form of an altar of four sides. On it was placed the corpse upon a couch. The eyes of the deceased were opened, the near relatives kissed the body with tears; and then, turning away their faces, they applied the torch, while upon the burning mass were cast perfumes of myrrh and cassia, the clothes and ornaments of the dead, and offerings of various kinds. At an officer's funeral the soldiers made a circuit three times round the pyre, the ensigns reversed, the trumpets braying, and the weapons clashing. If he had been very popular, the soldiers cast their weapons upon the burning mass as loving offerings to their dead commander. The ashes were then gathered and put into an urn. Thus preserved, they were deposited in one of those tombs which still adorn the stately roads of Rome. Often lamps were kept perpetually burning in the tomb, while flowers and chaplets were brought thither, that the dead might be reminded of the loving memory of the living.

This mention of the burning of the body in ancient times leads naturally to the question of cremation, which is attracting attention to-day, not so much in lands of sparse population as in lands such as England, Belgium, and Italy, where the population is dense and the available space small. In the large cities of such lands, cities which have been populous for hundreds of years, it is not a matter of mere sentiment; it is a matter of almost life and death to the inhabitants. And few persons will, I think, deny that cremation will be eventually adopted in place of earth-burial. This on grounds which will suggest themselves to all. It was, in fact, Christianity that caused the reintroduction of earth-burial, for Christianity taught the resurrection of the body. This is the reason why the Churches have always opposed cremation. But it is seen now, apart from any theological argument, that there can not be a bodily resurrection, as the same particles of matter form, in the course of time, parts of various bodies, decaying nature ever springing up to blooming life.

The objects of interest lying about the funeral pyres and burial mounds of the human race in its long, long march are so

many and so full of interest that one knows not where or when to stop. There is the burial at sea—the most solemn of all—when upon the mighty ocean the little group gathers round the captain, and he commits the body to the waters until that day when "the sea shall give up her dead." There are the rare forms of funeral ceremonies; for, although the chief are those I have mentioned—earth-burial, burning, and embalming—yet these are not all. Some races merely expose the body without any protection, as some others actually put to death the aged and infirm. Strangest of all, the Parsees of India expose their dead to the fowls of the air on the Towers of Silence at Bombay, holding that earth, or air, or water may not be desecrated by contact with the lifeless body.

There are the great funerals of the world: of Alaric the Goth, the conqueror of Rome, who was inclosed in a golden coffin and buried in the bed of a river, which had been turned aside for the purpose and then turned back, those who knew the spot being put to death. Of Alexander the Great, from Babylon to Egypt, the grandest funeral the world has ever seen. Of Napoleon, the modern Alexander, when

> "Cold and brilliant streamed the sunlight
> On the wintry banks of Seine;
> Gloriously the imperial city
> Reared its pride of tower and fane;
> Solemnly with deep voice sounded,
> Notre Dame, thine ancient chime,
> And the minute-guns re-echoed
> In the same deep, measured time;
> While, above the cadenced cortége,
> Like a dream of glory flits,
> Tattered flag of Jena, Friedland, Arcola, and Austerlitz."

Of the good Queen Eleanor, wife of Edward the Confessor, that wife "whom living he had loved, and dead he had never ceased to love," and whose body the great king followed on foot from end to end of England, setting at each stopping place a cross, until he came to Charing Cross, in the very heart of London to-day, whence the body was borne to its final rest in England's mighty abbey. Of Israel's great leader on

> "Nebo's rocky mountain height, on this side Jordan's wave,
> Where, in the land of Moab, there lies a lonely grave;
> And no man knows that sepulchre, and no man saw it e'er,
> For the angel of God upturned the sod, and laid the dead man there."

Of Him who was laid in the rock-hewn tomb of Calvary, "the man of sorrows and acquainted with grief." Time does not permit us to dwell upon these, or upon the literature of the tomb—Longfellow's God's Acre, Gray's Elegy, Milton's Lycidas, and

scores of others. There is just one thought in conclusion. It is that the funeral customs of the world, although not a conclusive, are yet a very strong argument in favor of the belief in the immortality of the soul. For the impelling motive in all these customs has been that death does not end all, that there is a life beyond the grave. This it is which has prompted the savage to lay offerings on the grave, that the spirit may return and accept them. This it is which prompted the Egyptians to embalm their dead, that the earthly form might one day be reclaimed by its former possessor. This it is which has prompted the preservation of the body by secure burial, that it may not be consumed by wasting time. This it is which has inspired the burning of the body, that the soul may be free from its earthly fetters. Now, how are we to account for this worldwide belief? I mean, unless there underlies it a basis of fact. To have implanted this belief—unless it has a fact as a basis—would seem to be but mockery on the part of an all-wise, an all-good God.

POETRY AND SCIENCE.

By WILLIAM H. HUDSON,
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IN his able and suggestive essay on Cosmic Emotion, the late Prof. Clifford pointed out the significant fact that in the development of thought the feelings never quite keep pace with the intellect. It is not hard to see why this must be so. Every new achievement of science, every fresh acquisition of knowledge, makes its appeal directly to the intelligence; and the judgment so far as it is clear and unbiased, decides all questions at issue purely on the merits of the evidence laid before it. Any revision of old formulas, any restatement of old theories cause no friction, and are made as a matter of course. But meanwhile each such fresh achievement or acquisition enters at first as a disturbing factor into the emotional conditions of the time. Every generation finds itself in possession of a certain body of knowledge concerning the universe, and a certain philosophy of life based upon that knowledge; and between such knowledge and philosophy upon the one hand, and its average emotions upon the other, there is, as the result of long action and interaction, an adjustment or equilibrium which at the outset is relatively complete. The doctrines of Nature and human life in the midst of which men have grown up have become so familiar to the common mind that the feelings have had ample time to play round them, to saturate them, to make them their own. Presently a sudden discovery,

or the rise of a new hypothesis concerning the world, causes unlooked-for expansion of thought. Unknown aspects of the universe are brought to light, hidden processes revealed, undreamed-of conceptions introduced. What follows? The traditional balance between knowledge and emotion is disturbed. The intellect adjusts itself rapidly to the changed conditions; the emotions cling tenaciously to the conditions that are being left behind. Years, perhaps generations, have to go by before once more the intellectual possessions of the age are brought into sympathetic relation with its common feelings and aspirations, and the adjustment in this way approximately restored.

Illustrations of the principle here outlined may be found without going further than the experiences of our own lives. We all know well enough that at a time of great emotional stress or upheaval we tend to revert to those ideas of our earlier days which we fancy we have outgrown, and which in calmer seasons no longer have any hold upon us. This is so notoriously the case that much capital has been made in theological literature out of the undeniable fact that during periods of unusual excitement—during periods, that is, when the feelings take the upper hand—the most skeptical spirits are apt to be driven back from the open sea of doubt to the safe anchorage of their boyish faith. It is a trite remark, too, that long after the judgment has been convinced of some new proposition, the feelings will still persist in protest and opposition. "A man convinced against his will is of the same opinion still," as Hudibras long ago told us. Now all this, in view of our generalization, is precisely what we should expect. The feelings in most of us are very imperfectly adjusted to our new intellectual acquisitions and their philosophical consequences; hence, in times of crisis, the almost inevitable lapse into our older thought of the world, and our cruder guess at the riddle behind it. In other words, the most advanced thinker is likely to be more or less conservative upon the side of his emotions. And all this explains not only the conservatism of women and elderly men, but also the constant tendency among those engaged in the study of the problems of life to segregate into opposing parties, roughly definable as the theological and the scientific —those who, guided mainly by the feelings, resist the new knowledge of the age; and those who, looking at facts from the point of view of the insulated intellect, accept such knowledge, concerning themselves but little with the question of its emotional results.*

Now this generalization interprets for us certain well-known

* A striking commentary upon these remarks will be found in the wonderful scene between Clotilde and Doctor Pascal in Zola's novel, *Le Docteur Pascal*, chap. iv.

facts that have found their place in the history of every great crisis in thought. The religious emotions of every epoch, though they have this of absolute and permanent about them, that they belong to man's sense of the mystery that lies at the heart of things, find their immediate and concrete expression in direct relation to what is currently known and thought of the world and of man's place in it. By and by Science steps in, and shows that the popular cosmology is childish, and the philosophic structure erected upon it a mere house upon the sands; and in the shock that follows it is not surprising that so many fine religious natures should feel themselves unhinged. The emotions have clung about the old knowledge so long that when that old knowledge is swept away they too seem in themselves to be hollow and untrustworthy, and a numbing sense of chaos and utter inanity settles down upon the consciousness of the world. This is the experience through which mankind has passed in every age of unusual intellectual movement and revision; this is the experience through which, in these days, we ourselves are passing. The wail of anguish that goes up to Heaven as foundations that have stood the test of centuries crumble rapidly away; the despair of many who, driven hither and thither by adverse winds of doctrine, know not where to turn for comfort or hope; the Cassandra cry of not a few who would have us believe that all faith has gone forever—these are simply signs of the times, unavoidable accompaniments of the wrenching away of men's emotions from their old moorings under the pressure of that extraordinary influx of new ideas that characterizes the age in which we live. The progress of science during the past half century has been so rapid and continuous that the intellect has got a long way ahead of the feelings, and the world is overweighted by a large body of unemotionalized knowledge. This is the real meaning of our present predicament in thought. Only hereafter can dawn the epoch of readjustment between feelings and knowledge; only after many years of such ferment and commotion can men at last come to the understanding that the new thought, too, is religious and poetic, and will furnish a soil for all the higher emotions richer and more fertile than that which the deluge has overflowed.

The poet, more sensitive than other men to the subtle influences at work around him, finds himself in the storm and stress of such a transitional period adrift amid currents and countercurrents of thought, the trend of which is only dimly foreseen or guessed at by the scientists and philosophers themselves. He moves about "in worlds not realized," with many "blind misgivings," and much painful groping toward the light. Now, whatever else poetry may or may not be, and whether we define it, with Aristotle, as an imitation or, with Bacon, as an idealization

of the actual world around us, it is unquestionably the expression of an attempt on the part of the mind of man to deal with life from the standpoint of the feelings. It has been well said that while science is concerned with the study of the relations of things among themselves, religion and poetry are concerned with the study of the relations of things to us. This gives us the poet's problem. Regarding the new thought through the medium of the imagination, he has to inquire in what way and to what extent the changes in our conceptions of the universe and man brought about by science affect our emotional outlook—our feelings respecting our own individual lives, our sympathies with the lives of others, our attitude toward Nature, our hope for the future of the race here and of the individual hereafter.

What, then, will be the poet's response to the intellectual conditions under which he lives? Confronted as he is by this large mass of unemotionalized knowledge, what will be his message to his time? It may be one of passionate protest against or obstinate indifference to the revolutionary movement in progress around him, and which may seem to him to be taking all the charm from life, all the beauty from the world. It may be one of simple doubt and hesitation; a mere cry of Why? and Whither?—not so much an answer to the mute questionings of men, as a translation of those questionings into language and form. Or, in the third place, it may be a glimpse of coming things—an attempt to catch the new thought and force it to an emotional revelation. And as no man can wholly exclude the "element of necessity from his labor," or "quite emancipate himself from his age and country," * so in one or other of these three ways will the forces of the time influence and fashion the poet's work. His attitude will thus be one of reaction, of uncertainty, or of prophecy; his gospel a gospel of evasion, of skepticism, or of promise.

Hereafter I hope to sketch the history of the poetry of the nineteenth century from the point of view now indicated—that is, to study it in direct connection with the scientific and industrial movements of our time. Here, in the illustration of the above theory, I must content myself with the mention of a few typical names.

For the most distinctive example of the poetry of evasion we turn naturally to the pages of John Keats. Leave out of question the artistic qualities of his work, which have absorbed most critics, but which do not concern us here, and the most significant thing about Keats is his absolute indifference to the life and spirit of his time. The world about him was alive with fresh interests and hopes; watchwords of progress were in the air he

* Emerson, Essay on Art.

breathed; almost all his great contemporaries—Wordsworth, Coleridge, Shelley, Byron among the number—were more or less drawn into the eddying current of change; but Keats remained an outsider and an alien. He felt no thrill of enthusiasm for the development of knowledge and the march of the race, no young man's interest in the world's travail and hope. He never troubled himself to ask what direction the thought of the time was taking. He only knew and only cared to know that it was drifting in some direction away from the old landmarks that he loved so well, and he persistently resented the change, without, perhaps, even realizing what it actually meant. There was nothing, therefore, left for him, as he felt, but to emulate the "negative capacity" of the Elizabethans—to live in the midst of all this ferment without being touched by it.* So he built for himself a palace of art—"a lordly pleasure house"—and escaped through the imagination from the pressure of a world in which he had no part.

For Keats, then, knowledge emphatically meant disillusion. Reality, romance—these were essentially contradictory terms. To explain the processes of Nature was to remove them once and for all from the soft twilight of poetry, through which they loomed dim but beautiful, into the lurid white glare of actuality, where they stood out gaunt, naked, revolting. The sense of real things constantly present to break in upon his sweetest fancies, he could liken only to a muddy stream, the turbid current of which was forever sweeping his mind back to darkness and nothingness. In the well-known passage in Lamia about the rainbow, with its emphatic protest against philosophy, we have the man's horror of science, so frequently revealed elsewhere in his work by implication, set forth in a kind of formal declaration. Such an outburst inevitably reminds us of the diatribes in Mr. Ruskin's Eagle's Nest against physiology and what he calls Darwinism—perhaps the foolishest utterances to be found anywhere in his voluminous writings, which is itself saying a good deal. But, after all, perhaps the best commentary on the lines in question is Haydon's statement that, three years before Lamia saw the light, Keats and Lamb, while dining with him (Haydon), had agreed together that "Newton had destroyed all the poetry of the rainbow by reducing it to the prismatic colors." We may imagine how these two sage critics would have laid their heads together over the more modern legend of the cynical chemist who is said to have remarked that a woman's tears had no longer any kind of power over him, since he knew their precise constituent elements —muriate of soda and solution of phosphate! Clearly, the æs-

* See his remarkable letter to his brother, on Shakespeare's "negative capacity," in Forman's edition of Keats's works, vol. iii, pp. 99, 100.

thetic emotions of Keats lagged far behind the intellectual achievements of his time; and it was the consequent maladjustment that caused him to cling so persistently to that old order of ideas, to that cosmology of marvel and catastrophe which he felt to be slipping away from the world with all the beautiful accumulation of legend and myth which in the course of many centuries had come to cluster about it. To him "glory and loveliness" had indeed "passed away" from the present, and could be sought only in the things that the general world was rapidly outgrowing; and hence it was to these dead things alone—to Greek fable or mediæval story—that he could turn to find the beauty that was to be to him a joy forever.

But though in Keats's day the ocean of knowledge was slowly rising on every side, he had no hint of that great tidal wave of new ideas which has carried us so rapidly forward with its resistless roll. It is little to say that during the past half century the consequent emotional perturbation has been greater than the world ever experienced before; for the single generalization of evolution has disturbed the equilibrium of which we have spoken to an extent hitherto undreamed of. We face the universe from a new standpoint; our relations to Nature are altered; the problems of life, so often analyzed, so much discussed in the past, meet us in unfamiliar forms. Amid the Babel of tongues and the fierce clash of ideas and purposes to which all this has given rise, the poetry of evasion has still made its voice heard and its influence felt. In the works of Rossetti and the earlier writings of William Morris (The Earthly Paradise and the other poems antedating his conversion to socialism) we have the artistic traditions of Keats carried on with unmistakable success; the mediæval mood and attitude, however, replacing the pagan mood and attitude of the earlier bard. Both these men, too, sought to make their escape through the imagination from the life of their own time—from the rapid material changes going on in every direction, and from the speculation and inquiry with which the whole air is alive. The prelude to The Earthly Paradise, taken even by itself, makes Morris's position sufficiently clear, and to understand Rossetti's we have only to remember his own declaration of his belief that it concerned men and women far more to attend to the form of their tables and chairs than to bother about the doctrine of the conservation of energy and the hypothesis of natural selection.

Meanwhile, in the early years of the modern upheaval, a note of deeper meaning made itself heard—the outcry of earnest natures, conscious of the breaking down of old standards, but doubtful as yet of the spiritual import and tenor of the iconoclastic forces at work. To turn from the poems of Keats, Rossetti, and Morris, to the poems of Arthur Hugh Clough and Matthew

Arnold, is to turn from the poetry of evasion to the poetry of skepticism. Here we find, as the burden of all their song, not the reactionary indifference of the simple artist, but the eager probing of the inquirer. Clough and Arnold are modern men, standing face to face with the problems of modern life. There is in their works no hatred of the new knowledge for itself, no intellectual cowardice regarding it; on the contrary, every fresh insight into the methods of Nature and the laws of life is welcome; but there is, at the same time, painful realization of the fact that the old foundations of the emotions are being sapped and undermined. What will be the result? Will science in this respect prove constructive as well as destructive? Will new emotional bases be given in place of those swept away? Or, will all the immemorial desires and aspirations and spiritual cravings of humanity be left to perish in grim despair before the blighting breath of a crass materialism which recognizes no sanctities and holds out no hope? These are the stubborn questions which, in one form or another, are put again and again, and for the most part left unanswered, in the poetry of the men to whom we now refer.

Clough's poetry, though little read to-day, and lacking almost every element of popularity, is of the utmost interest for those who care for the study of literature from the point of view here adopted. It was with little exaggeration that Mr. Lowell adjudged him the man who most probably "will be thought, a hundred years hence, to have been the truest expression in verse of the moral and intellectual tendencies, the doubt and struggle toward settled convictions, of the period in which he lived." He was the plaything of conflicting tendencies, which he saw he could not harmonize. Everywhere in his poetry the striving after truth is accompanied by a distressing realization of emotions out of touch and keeping with his intellectual environment. "What I mean by mysticism," he writes in one of his American letters, "is letting feelings run on without thinking of the reality of their object, letting them out merely like water. The plain rule in all such matters is, not to think what you are thinking about the question, but to look straight out at the things, and let them affect you." This is the sane utterance of a manly nature, alive to the manifold dangers of unchecked speculation, and not to be deceived by theological or metaphysical jugglery into any false sense of security. To hold fast to reality—that he saw was the prime requirement, to be fulfilled at any cost; and to seek for emotional excitation in what has been proved to be no reality, but a figment or shadow, would have seemed to him the willful blindness of folly or the despicable subterfuge of cowardice. But was the reality itself capable of furnishing scope for that emotional satisfaction which his nature demanded? Sometimes with more, sometimes

with less of hope, he approached this obstinate issue; but the answer of the sphinx was still, as it were, couched in riddles. Thus his message to men was almost always a message of moods; brief seasons of faith alternating with other seasons in which the sense of loss was so strong upon him that he was tempted to struggle to save some floating remnant, worthless though it might turn out to be, from the universal wreck of belief that was going on around him.

An equally characteristic and far more considerable exponent of this attitude and mood of mind was Clough's friend Arnold. It was his mission, too, to give poetic voice to the emotional restlessness and craving which—inevitably as we now see—went along with the intellectual progressiveness of his age. Arnold (whose verse and prose, earlier and later, treatments of these themes furnish subject-matter for most instructive contrast) has given us the key to his position, while at the same time he has shown us how acutely that position was realized by him in the familiar lines in the splendid Stanzas from the Grande Chartreuse, in which he describes himself as "wandering between two worlds, one dead, the other powerless to be born." The old faith had gone with the old theories of the universe and man, and the new theories of the universe and man had not yet revealed themselves in a religious light, or even shown themselves capable of such revelation. For the time being they were hard, dry facts of science merely; that they would ever be more than this was far from clear. Hence "the hopeless tangle of the age," the "strange disease of modern life," the sense of futility and despair, so characteristic of the large body of his poetic work. In the wonderful poem just above referred to—a poem that can hardly be read too often or too carefully as an exposition of the spiritual conditions of the man and his time—all this is made particularly clear. Why does Arnold linger among the shadows and traditions of the old Carthusian home—he a skeptic of the later time? Because he is seeking sadly for the spiritual comfort which all the while he knows he can never find, either in the old creed, because he has intellectually outgrown it, or in the new, because he has not yet emotionally appropriated it. Thus he must let the world go its way, with some hope for the coming race of men, perhaps, but for himself and his own time, none.*

For Clough and Arnold, then, knowledge and feeling were out of harmony; yet at times they seem to have caught glimpses of

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* The skepticism of Arnold and Clough is to be found deepened to absolute despair in the works of many of the minor verse-writers of the time—as notably in that superb expression of pure pessimism—The City of Dreadful Night. But conditions of space forbid my following the matter into these further details.

the possibility that the disturbance of relations from which they suffered so keenly might ultimately be overcome. That the far-off future might at length bring "a solemn peace of its own"—this in serenest hours was their larger faith. Fortunately for the world, stronger poetic voices were already making themselves heard in the declaration that the epoch of readjustment might haply be near at hand. While some men were busy railing at the new science as dismal, prosaic, irreligious, and others were painfully asking whether, real and certain as were its revelations, they could ever come to mean anything to the soul of man, there were still those who, with greater receptivity and more prophetic vision, saw that the new science itself, when once sympathetically envisaged, could even perhaps for this generation provide the spiritual impulses, the religious and poetic fervor, which the old knowledge, with the philosophy of life belonging to it, had furnished for the generations gone by.

The mass of men, let us repeat, can only achieve this readjustment of their feelings to their knowledge, this emotionalization of newly acquired fact, by a slow and painful course of adaptation. The discoveries and inductions of science must grow familiar through habit and association before they can take a poetic or religious coloring for the average mind. But it is exactly here that a great poet's best work may be done. He can lead the way. Taking the generalizations of the scientist and the philosopher as they stand in exact and unimaginative statement, he may illumine them with his genius, and as he sets them in their proper light and pierces into their inner natures, the world, for the first time begins to apprehend their beauty and to seize their spiritual meaning. It is then that men are thrilled, as Emerson puts it, by the influx of a new divinity upon the mind. It is, in a word, his special mission and privilege to stand forth as the emotional interpreter of the intellectual and material movements of his age.

Hence arises the all-important question, Does our modern poetry show any tendency toward the absorption into itself of this vast mass of unemotionalized knowledge by which we now stand confronted? It is manifestly too early as yet to expect any full emotional development of this new material, but are there signs of a movement in this direction? Can we yet pass from the poetry of evasion and the poetry of skepticism to a poetry that we may fairly call the poetry of promise?

The name of Tennyson inevitably presents itself in this connection. In the writings of this poet—the last of the true Victorian brotherhood—we find, it need hardly be said, the sad, skeptical note of Arnold often enough repeated. Not planting himself, as Browning did, upon the strong rock of a transcen-

dental philosophy, he was shaken by storms of doubt and difficulty that seemed to have nothing but a tonic effect upon his more robust contemporary. Struggle, uncertainty, hesitation are revealed throughout the whole of his work; he holds his faith with infinite effort; even In Memoriam, as he told Mr. James Knowles, was more sanguine than the man himself; and he got but little beyond a "faint trust" of "the larger hope." Yet there are other sides to Tennyson's writings that reveal the man in a very different light. His keen interest in science; his sympathetic hold upon the vast movements in progress around him; his manly attitude toward the changes that life and thought were everywhere undergoing; his reiterated belief that we are but in the morning of the times—the "rich dawn of an ampler day"; his faith, only now and then shaken, in the years that are still to come—all these characteristics combine to render Tennyson the most intensely modern of all our modern poets.

> "Let knowledge grow from more to more,
> But more of reverence in us dwell,
> That mind and soul, according well,
> May make one music, as before,
> But vaster."

There is the very index to Tennyson's intellectual position. And a very casual reading of his collected works will suffice to show how large an expression many of our new scientific conceptions find in his utterances. The underlying principle of all our modern thought—the doctrine of the universality of law, and of that orderly progression or development within the domain and under the influence of law which we call evolution—these principles constitute the firm foundation of the entire fabric of his philosophy of life; they characterize his attitude toward the external world; they mold all his social and ethical teaching; out of them grows his faith in the destiny of the race, his hope for the untried future. For him, man is as yet "being made"; the "brute inheritance" clings about him; but, because so much has already been accomplished, much more will be accomplished by and by.

> "This fine old earth of ours is but a child
> Yet in the go-cart. Patience! Give it time
> To learn its limbs. There is a hand that guides."

Above all things, it seems to me significant that, with all the reaction against the cry of progress that undoubtedly marks some of his later poems, the evolutionary note comes out with ever-increasing strength to the very end. It should not be forgotten that such poems as The Dawn, The Dreamer, and The Making of Man all belong to his last published volume.

To go into further detail would be impossible; limits of space are already exhausted. Passing reference only can be made to the fact that, while in Tennyson's works, upon the whole, we find the fullest poetic interpretation as yet given to modern thought, writers like Browning, Whitman, and Emerson, and among those still living Robert Buchanan, William Watson, and Mathilde Blind, have each of them revealed in different ways a healthy tendency on the part of poetry to look at the facts of life from the point of view of present thought rather than from the point of view of past thought, and to recognize the supreme fact that if we find cause to complain, with William Morris, of the emptiness of our own life, it is the fault of ourselves and not the fault of our times. But here the subject must be left for the present; and the discussion of many important questions arising in connection with the above-outlined theory, held over till a more convenient season. Enough, perhaps, has been said to indicate the view we have been trying to develop of the relations of poetry to science, to show that there is no essential antagonism between them, and to point out that recognition of the one as the supplement of the other does not at all imply, as is so often thought, any absurd confusion of their methods and aims. For myself I read without fear the French critic's prediction that fifty years hence no one will care to read poetry. "Of all forms of mistake, prophecy is the most gratuitous," says George Eliot, and such a statement may be quietly disregarded. On any large principle of education, poetry has its secure place in the scheme of life; but our emotions must respond to our knowledge, not our knowledge to our emotions. The business of the poet in his capacity of spiritual teacher is to help us to clothe fact with the beauty of fancy; not to try to force fancy into the place of fact. Let us understand what is scientifically true, socially right, and our feelings will adjust themselves in due course. It is for science to lead the way, and the highest mission of the poet is ever to follow in the wake, and in the name of poetry and religion claim each day's new thought as his own.

THE locality of Florissant, Colorado, a lake deposit of the geological age called Oligocene, is famous for the extraordinary abundance and variety and the excellent condition of its insect remains. No group of insects perhaps, according to Mr. Samuel H. Scudder, shows this more strikingly than the family of "crane flies" or "daddy longlegs." Several hundred species have been collected there, and in a very considerable number of them, representing many species, the venation of the wings is completely represented with all their most delicate markings, and also the slender and fragile legs with their clothing of hairs and spurs, and, to some degree at least, the antennæ and palpi. Even the facets of the compound eye are often preserved as in life.

ASTRONOMY OF THE INCAS.

By M. JEAN DU GOURCQ.

THE traveler who in these days penetrates to the high plateaus of upper Peru and Bolivia, explores the basin of Lake Titicaca, and returns to Cuzco, is struck with the great number of ruins, hieroglyphic inscriptions, broken pottery work, and *huacas* which he meets at every step. They are the relics of the fanaticism of the conquerors and of their unbounded rapacity. Of the magnificent palaces adorned with gold and silver, the temples of the sun glistening with jewels, and the astronomical columns which stood at all points in the country from La Paz to Anito, there remain nothing but fragments of crumbled walls, an infinite number of pieces of bricks, deformed and mutilated statues disintegrated by time, blocks of granite and basalt standing in the deserted fertile lands like black ghosts, and at long distances apart a few tombs which have been forgotten by the Spaniards. The monuments standing at Tyahuanaco and on steep hills difficult of access, and in the archipelagoes of Lake Titicaca, although dilapidated and also victims of the hands of iconoclasts, deserve serious attention on account of their relatively good state of preservation.

Popular superstition has, furthermore, contributed no little to preserve the ruins of Lake Titicaca from complete spoliation.

Why are not more pains taken to send out scientific expeditions to these regions, to study the ancient civilization of the Incas? A work might be undertaken there of like nature with that which has been accomplished in Egypt by Champollion and Mariette Bey. Much that is valuable has been done there, it is true; but the whole story is still far from being told, and I am confident that *huacas* have many secrets and surprises in reserve for us. The astronomy of the Incas, a curious side of Peruvian civilization, while it has been lightly touched upon by some of the American reviewers and superficially noticed by a few explorers, is yet almost wholly unknown to us. Some even, of whom Mr. Wiener is one, have gone so far as to deny that astronomy existed among these peoples, or to reduce it to simple rudimentary notions. Yet we have only to keep our eyes open in passing through the country, or to consult the contemporary annals of the conquest, to be assured that their science was not a mere chimera or a legend invented to amuse. It would be strange, indeed, if a people whose only cult was the worship of the stars had not been moved to study the nature, movements, and phenomena of the heavenly bodies, and had not attempted to explain them in some way.

The proofs that the Incas . . . had a real system of astronomy are scattered, partly in what remains of the monuments that were consecrated to the sun, and partly in the accounts of historians—accounts which, whether because their importance has not been suspected, or because of the difficulty of quoting them, most of them having been printed only once, others having remained in the state of manuscript, and very few of them having been translated, are but little known to men of science. Whatever the verity of the legends preserved in these accounts, we find a comparatively highly developed astronomical system among the Incas, of which the most interesting parts are here given from rare documents already published, and from American manuscripts and traditions. The work has not before been done so completely.

Six nations only—China, Mongolia, India, Chaldea, Egypt, and Australia—had, before the discovery of America, divided the visible celestial sphere into constellations, and had used figures of their own invention to represent them. The Peruvians, although situated at the meeting of the Northern and Southern hemispheres, did not extend their division over the whole sphere; they recognized and studied only a few of the more brilliant constellations, like the Pleiades, the Jaguar, the Standard, the Southern Cross, and some other groups which have not yet been identified.* It is probable that they extended this division further than the first historians—who were not learned in astronomy, and could therefore pay little attention to all the details—represent. Later writers speak of other constellations which they do not mention. The Incas called the milky way the dust of stars, and gave names to its different parts. What is now called the Coal Sack was figured by them as a doe suckling her fawn—a simple and poetic transformation of the Grecian and Aryan legend of Hercules and his nurse.† A few stars of the first magnitude, such as Capella and Vega, had special names.‡ It is almost impossible that the Incas should have failed to give distinct names to the splendid stars of the Southern hemisphere, such as Sirius, Canopus, Achernar, etc. The silence of historians respecting this point is far from being conclusive, and may be accounted for by supposing that many of these stars not being visible in our hemisphere, they did not ask the natives for their names, and limited their inquiries to the stars of the Northern hemisphere which they knew.

The only planet which the Incas had discovered was Venus, which they called the hairy, on account of the brightness of its

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* Acosta, Histoire des Indes, 1591, Book V, chap. iv.

† Garcilaso, First Part of the Royal Commentaries, 1609, Book II, chap. xxiii.

‡ Acosta. Cælius, Cælum astronomico-poeticum, 1662, chap. xix.

rays. They said that, being the most brilliant of the stars, the sun would not permit it to be separated from him, and obliged it to attend his rising as well as his going down, just as at the courts of kings only the most distinguished lords and the handsomest ladies were admitted to the ceremonious royal risings and retirings. It appears nearly certain that the Incas spoke of Venus under two different names, according as it preceded or followed the sun. To this day the native Peruvians name it, in fanciful language, the eight-hour torch and the twilight lamp. As this star served to show the Indians when it was time to prepare the maize for cooking, they also gave it a name indicative of that act. A chapel in the Temple of the Sun was consecrated to this planet.

The phases of the moon were well known to the people, and they attributed life and movement to it. When the moon was invisible, during the days preceding the first quarter, they said it was dead, and would rest three days in the tomb, beyond the snowy mountains and the immense ocean. Then it would rise again, to their great joy. To the people of Asia and North America the spots on the moon represented a rodent—a hare or rabbit—or a human being. The Incas perceived in it a young woman, and said that once upon a time the daughter of the king, walking in the light of the moon in one of those limpid and blue nights peculiar to the tropics and to these latitudes, suddenly fell in love with the star of the night. Desiring to possess him, she went and hid herself in the top of a mountain by which he would pass, sprang upon him at a favorable moment, and became one body with him.* The moon, called by names which signified sister or wife, was regarded as the first wife of the sun, and was represented by a silver plate bearing a woman's face. It, too, had its sanctuary, occupying a station of honor in the temple of the supreme god.

The difference between the seasons not being distinctly marked in Peru by variations either in moisture or temperature, it was important to make very careful observations in order to determine the times for planting and harvest. The only method was by experiment. The attention of the ancient Peruvians was particularly directed to the time when the sun passed the zenith, for then it cast no shadow at noon. They also observed it very carefully at the June solstice when it was seen nearest to the horizon; and they succeeded, as we shall see, in giving their observations scientific precision.† The solar spots had also been observed.

In explanation of the circular motion of the sun, the Incas said that it was hung in space by a cord; that it entered the sea in the

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* Garcilaso.

† Montesinos, Antiques Mémoires du Pérou, Book II, chap. ii, in manuscript at the Library of the Academy of History, Madrid.

evening, passed under the earth, and reappeared twelve hours afterward in the opposite part of the horizon.

The god himself was represented in sculpture, according to M. Wiener, in statues of gold or reddish-brown porphyry, with "his forehead encircled by the royal fillet in the midst of four fabulous animals moving around him." The same author, on the evidence of some monuments resembling the menhirs of the Druids, gives another explanation of the circular motion of the sun. "It is regarded," he says, "as a being which comes to rest at night after its daily march, in the inaccessible inclosure of the sanctuary (called by a Quichua term signifying the place to which the sun is attached). The holy object consists of two granite blocks about a metre in height, on the inner faces of which have been found holes about fifteen centimetres deep and nine centimetres in diameter." This was narrow quarters for a star as voluminous as the sun! We shall find further on that M. Wiener gives the same name to a system of observatories. The illustrious Peruvianologist has confused this word with the identical one which represents the year in the Quichua language.

The earth was believed to be flat and circular, and the center of it was shown in the sanctuary of Cuzco, the name of which, according to Garcilaso, signifies umbilicus, or navel. The Greeks had a similar belief, and located the center of the earth in the Temple of Apollo, another solar deity, at Delphi, which they called Ὀμφαλος, the navel of the inhabited world. It is celebrated under that title in some of the Pythian odes of Pindar. The earth, the Indian name of which signified "everywhere," was the only one of the stars that had no sanctuary in the Temple of the Sun. Like the peoples of the Aryan race, the Incas did not suspect that it was endowed with motion. Only the revolution of the stars existed to them; and the earth, instead of being a planet suspended in space, gravitating round the sun, and turning upon itself, was supposed to be fixed in the midst of a moving celestial sphere.

When the moon was eclipsed the Incas supposed that it was ill, and uneasiness prevailed whenever it appeared obscured. If the eclipse was total, they supposed that the star was perhaps dead, and that, not being capable of maintaining itself in space, it would fall to the earth, crushing the poor mortals thereon and that the world would come to an end. For this reason when an eclipse of the moon was beginning—an event they were not able to predict—the Incas with such instruments as were within their reach—drums, trumpets, cymbals, etc.—made a frightful noise, and, tying up their dogs, tormented them so as to extort the most hideous cries from them, in the hope that the moon, being a friend of dogs, would be softened by their howling and try to return to life. Men, women, and children joined with their princes

in conjurations to avert the catastrophe. As long as the eclipse continued they kept exclaiming, "*Mama-quilla, Mama-quilla!*" which might be paraphrased, "God save us!" and they supplicated the sun to aid them. After the eclipse had passed away they sang in chorus the praises of the god Pachacamac, who had cured the pale star of night. Garcilaso adds to this story that these practices were all still in vogue in his time—that is, a half century after the conquest.

Mention is made in the Memoirs of Garcilaso of a comet which appeared at the time of the death of the Inca Huascas, and of another which was visible some time afterward, while Atahualpa was a prisoner of the Pizarros. These apparitions were regarded as annunciations of imminent woe. So, likewise, were shooting stars, of which an extraordinary fall took place during the reign of the same Inca.* Montesinos speaks of the appearance of two comets during the reign of Yupanqui—one had the form of a lion, the other of a serpent. "The sun," he wrote, "had sent these two animals to destroy the moon. So the Indians directed a hailstorm of stones at the lion and serpent to veil their light and prevent them from tearing the moon to pieces, for if they succeeded in carrying out their purpose everything on the earth would be changed into savage and hideous beasts, women's hair into vipers, and other things into bears, tigers, and similar evil creatures." The Indians still believe that the shooting stars drop from the sky, and utter prayers for deliverance when they see them.

The Inca year was originally divided into twelve lunations, each of which had its special name. But experience having shown that this lunar year was ten or twelve days shorter than the solar year, a reform was determined upon. Montesinos asserts that an assembly of *amantas* in the reign of Agay Manco thoroughly rearranged the calendar, dividing the year into three months of thirty days each, and the month into three weeks of ten days each, and adding to complete the solar year a half week of five days, which was made six days every fourth year. The Inca Yahnar Huquiz, grand astronomer, soon discovered that an error of one day would appear after four hundred years in the calendar thus instituted! The Indians reckoned time by this system till the Spaniards came.† Garcilaso says that the Inca Tapac Yupunpuy discovered, three centuries before the conquest, that the period between the solstices was three hundred and sixty-five days and a quarter, and that he caused the intercalation of ten days and a quarter, distributed among the lunations, in order to make the lunar and solar years agree. Is it not strange to see the Gregorian calendar invented and applied by the Incas three hun-

* Garcilaso, Book I, chap. xxxiv.

† Montesinos, chapters xi and xii.

dred years in advance of the Europeans? The year was called by a name derived from a Quichua word signifying *to bind*, and the half century of fifty years was figured by the hieroglyph of a bundle of reeds tied with a ribbon. Each of the twelve months was named after its principal festival.

In the month of December a peculiar dance, in which only men participated, was performed with great solemnity on the plaza in front of the Temple of the Sun at Cuzco. Offerings were made to the divinity of lamas, which were burned on pyres of odorous woods; and birds and various animals, but rarely human victims, were sacrificed. The dances followed, representatives of all the provinces taking part in them. These dances were instituted by Huayna Capac, the twelfth Inca. Two or three hundred men, holding one another's hands, executed a kind of farandale, stepping in concert two paces forward and one backward, so that they constantly gained ground, and all the time singing of the exploits of the Incas. Huayna Capac had a golden chain made which they all took hold of. It was as long as the two plazas of Cuzco, and was composed of rings of the diameter of the sun. The Indians hid it carefully at the time of the arrival of the Spaniards, and a legend relates that it was thrown into the depths of Lake Titicaca. The young Incas appeared at this festival, according to the expression of the historian Balboa, as armed knights. The sages charged with their education prepared them for the solemnity by scourging them with leaves and rubbing their figures with the blood of the offered lamas. The blood of the lamas and other victims also flowed in January, February, March, and April. The feast of the corn harvest was celebrated in May, and was held in the Gardens of the Sun, on the hill *Colcampata*. The people intoxicated themselves with a fermented drink (*chicha*), made from corn and fruit, and danced in masquerade.

For the June festival, which was dedicated to the sun, rude statues of men and women were made and covered with rich vestments. The courts of the temples were strewn with flowers, and the reigning Inca, with the chiefs of the tribes, executed sacred dances. The feast of the Pleiades is still celebrated in this month. In July and August spotted lamas and pigs were sacrificed, as an offering to obtain abundant crops.

The vernal equinox was celebrated in September. All the idols were collected in one place previous to the rising of the moon. As soon as the star appeared above the horizon the Indians uttered loud cries for the aversion of harm, and struck one another with whips of burning straw; washed in a running brook; and, on their return, sacrificed a hundred white lamas. They kept intoxicated for four days, and ate cakes prepared by maidens with the blood of the victims. Another hecatomb was

offered in October, and in November the princely youth who were to be given arms in the next month had their ears pierced.*

These Peruvian ceremonials were very like those which Ovid has described. They were not the only ones; an edict of the Inca Pachacutec mentions three regular festivals occurring in each lunar month; there were also days for fairs and markets, and a rest day occurring every nine or ten days, like the *nondines* of the Romans, but not corresponding either with the quarters of the moon or the week, although the phases of the moon were well known to the Incas. As their lunar year fell behind the true time, they rectified their calendar constantly, trying to make it conform roughly with the phases of the moon.

The hours were not determinate spaces of time corresponding with a mathematical division of the day, but simple indications of such conditions as dawn, or morning, noon, sunset, and night.

The astronomical observations of the Incas were at first very elementary and empirical. They marked the day when the sun passed over the zenith. An experiment of the simplest character will be sufficient to account for the conclusions they drew from this observation. If we plant a stick vertically, and observe the shadow which it casts when shone upon by the sun, we shall find that at noon toward the end of December, this shadow is very long and directed toward the north; then it diminishes gradually till the day when it is shortest at noon. In the Southern hemisphere the shadow follows an inverse direction to this, and is longest at noon in June and shortest in December. The days when the shadow is longest, beyond the tropics, are the same for all places in the same hemisphere. But the days when there is no shadow at noon are not the same for all latitudes in the same hemisphere within the tropics. A day's difference exists for every forty kilometres. For this reason the Incas established observations at different distances from north to south, over the whole extent of their empire.

In order to verify the equinoxes, the *amantas*, or astronomers, arranged richly sculptured columns in the courts of the temples of the sun. On the approach of the equinox, they observed the shadow projected by the columns. These were placed in the center of a large circle through which a line, exactly oriented by experiment, ran from east to west. When they saw that the shadow struck this line in the middle, and that at noon the column was bathed with light on every side, they announced the equinoctial day. They then adorned the columns with flowers and fragrant herbs, and brought offerings of gold, silver, precious stones, and fruit to the god. The *gnomon*, or column, was surmounted

* Desjardins.

by a throne of massive gold, in which the sun was to come and sit on that day, illuminating the tower on all sides.

The *amantas* perceived that only four moons passed when the shadow was turned toward the north, while there were eight moons when it was directed toward the south. They did not take into account that their observatories were situated between the equator and the tropic of Capricorn. But when the Incas had established their residence at Quito, their men of science immediately remarked that the two shadows were equal, and that the duration of their variations was exactly six moons. This is why the columns called equinoctial at Quito were especially venerated as the favorite abode of the great divinity.

Mr. Wiener mentions another astronomical apparatus which was intended for the precise verification of the time of the equinoxes: "A vertical well, dug mathematically in the line of the zenith, twice a year, in spring and autumn admitted the rays of the sun and gave light in its lowest depth to a vast tunnel over which it was bored. These observatories were called *intihuatanas*. These *intihuatanas* were doubtless real, but the assignment of such a purpose to them was a work of pure imagination." This apparatus, ingenious as it may have been, is too sensibly removed from historical tradition and from the study of the ruins of the solar temples to have really existed. It should further be remarked that such an observatory could be mathematically of service only for the September equinox.

In tracing the meridian the Incas appear to have limited themselves to raising a pillar perpendicular to the line which the shadow follows on the day when the sun passes the zenith, and that they reached this result by a series of trials. This accounts for the variations of a few minutes offered in the orientation of some of the monuments.

The Inca method of determining the solstices was very striking, and nothing like it is found with any other people. On this interesting point we can not do better than literally translate Garcilaso, a descendant of the Incas by his mother, who was better informed upon it than any other writer: "The common people counted the years by the crops, and all were acquainted with the summer and winter solstices. They have left conspicuously visible marks of them. There are eight towers which they constructed at the east, and eight others which they constructed at the west of the city af Cuzco, arranged in fours, of which two, smaller than the others and about three stories high, were placed between two others much larger. The other two towers were much higher than those which in Spain serve as lighthouses in the seaports and as observatories on the frontiers. These were intended for the astrologers, to give them a good view. The spaces

between the smaller towers, being illuminated by the rising or setting sun, were for the solstices, and the towers on the east answered to those on the west, at the winter or at the summer solstice. In order to verify the event the Inca placed himself in a convenient spot, whence he watched whether the sun rose or set between the two small towers on the east and on the west, and thus the most skilled of the Indians found the astrology of their solstices.*

This description, equally naïve and unintelligible, requires some explanation. The towers and turrets went by fours, two large and two small, and there were two systems, intended for the observation, by one system of the winter solstice, by the other of the summer solstice. In position and relative distances they were so arranged that when the sun reached the tropic of Cancer the shadow cast by the northeastern turret was exactly tangential, at the moment of sunrise, to the southern face of the northwestern turret, and at the same time hid the sun from the *amantas* on observation in the corresponding tower; and *vice versa* at the moment of sunset. As the sky might be cloudy at sunrise, the astronomers posted to observe the setting sun replaced, confirmed, or rectified, when necessary, the determinations of the morning. The southern turrets were used in the system of observatories for the summer solstice.

Montesinos gives another version which seems different when taken literally, but substantially confirms the former. He relates that the Inca Capac Raymi assembled his learned men and astronomers to find the solstices. "There was a kind of solar quadrant formed by shadows, and with it they knew what day was long and what other was short, and at what time the sun went toward the tropics and returned from them. I saw four very ancient walls on a hill, and a son of the country affirmed to me that this building had served the ancient Indians as a clock." Though precise for that time and place, and quite original, no account has been taken in this method of the change in the obliquity of the ecliptic, forty-eight seconds a year, according to Delambre, the effect of which upon the azimuth is very sensible in those latitudes. Houzeau says that the Incas had no idea of this displacement; that they observed the June solstice only, and that the continued observations of the *amantas* proved the absence of a solar calendar. It is very possible that the Incas perceived that their observatory system finally became useless, and that, without stopping to inquire into the reason, they constructed new ones. There is no doubt that the Incas recognized the movement of the ecliptic some time before the other people of the Old World, but without

* Garcilaso, Book II, chap. xxiii.

comprehending it, without making the necessary deductions for it, and without including the important phenomenon in their calculations. Houzeau was mistaken in affirming that the Incas observed only one solstice. The historians are unanimous in describing a festival for each of them. We have seen, besides, that two systems of observatories existed, with towers and turrets in different positions, and consequently designed for the observation of two different solstices.

We need not, furthermore, presume that the people had no calendar, from the *amantas* observing the zenith passages of the sun every year. The day, hour, and minute of an eclipse are foretold now; yet astronomers are not prevented by this from studying the different phases of the phenomena.

The destruction of these observatories, which Garcilaso says were still standing in 1560, must be regretted. Those of Quito were destroyed by Sebastian Belalcazar, under pretext that they prompted the natives to idolatry. Only shapeless ruins of them are now to be found. The best preserved ones are at Cuzco, on the Carmenca hill. The question, long asked, whether the Incas used optical instruments, is now answered in the affirmative. Mr. David Forbes has brought from Peru a silver figurine, which represents a personage, probably an astronomer, holding to his eye a tube which is nothing else than a telescope. The figure is certainly of Peruvian origin, and dates from the period of the Incas.—*Translated for The Popular Science Monthly from the Revue Scientifique.*

In taking the recent census of India some difficulty was experienced, according to C. E. D. Black, in determining what should be regarded as a house. "The variety of structure was so great that a precise definition, such as satisfied census authorities in other parts of the world, became an impossibility in India. In the hill tracts one meets with collections of leaf-huts that are here to-day and gone to-morrow. Again, there is a portable arrangement of matting and bamboo that is slung on a donkey by the vagrant classes, though sometimes stationary on the outskirts of a village for months together. Then comes the more stable erection for the cultivator while engaged in watching his crops, and so on to the really permanent abode of the lower grades of village menials, with wattle and daub walls which last for years, and a roofing of thatch or palmyra leaves, renewed as necessary before each rainy season. In some parts of India a considerable space is walled in with a thick hedge of thorn or rattan, and the family expands in separate buildings as the sons marry, but all is considered to be a single 'house.' Pitched roofs, tiled or thatched, are usual in the moister tracts; flat-topped mud or brick buildings are almost universal in the dry plains of the Deccan and Upper India. Climate and the scarcity or plentifulness, as the case may be, are the main causes of the diversity of building; while social custom and the relative prevalence of the 'joint' or 'divided' family life among the Brahmanic classes often determine the interior construction and arrangement."

SKETCH OF ASAPH HALL.

IN spite of the few wonderful accidents that have led to great changes and advance in modern ideas, most of the real advances of the world have been the results of simple hard work and hard thinking by men of ability. As an example of the type of scientist who does not make astounding discoveries of doubtful value, but who surely and steadily advances the cause of science by faithful work, stands the astronomer ASAPH HALL.

He was born on October 15, 1829, in the little town of Goshen, in the northwestern part of Connecticut, where the Berkshire Hills come rolling over from Massachusetts. His grandfather, a Revolutionary officer, was one of the first settlers of the place, and was a wealthy man. But his father, through business failures, lost nearly all his property. In 1842 he died, leaving a wife and six children, of whom Asaph, then thirteen, was the oldest. Up to the time of his father's death Asaph's life was that of a well-to-do country boy. He had worked on the farm and he had gone to the village school. His father was far better educated than most of the men of the place, so that many good books fell into the boy's hands. Often his rainy days were spent in the garret, fighting the battles on the plains of Troy, or following Ulysses in his wanderings.

When his father died everything was changed. Almost all the property was mortgaged. In a family council it was decided to remain on one of the farms and try to pay off the mortgage. So Asaph and his mother set to work, and for three years toiled with might and main, carrying on the work of a large farm almost entirely by themselves. Asaph's mother was a tireless worker, and he helped her as best he could; but when the three years were past they found they had been able to pay the interest on the mortgage and nothing more. Sticking to the farm did not seem to pay, so Asaph decided to leave and go and learn the carpenter's trade. He persuaded his mother to move to a little place she owned free from debt, and he apprenticed himself to a local carpenter. He worked for three years for sixty dollars a year. At the end of that time he became a journeyman and worked for himself. He stayed in Litchfield County, helping to build houses and barns that are standing on the old farms to-day.

For six years he stuck to carpenter work, but all that time he was full of ambition. He saw that the men he worked with were a poorly educated set. They knew how to make a right angle by the three, four, five rule, but they had no idea at all of the reason for it. He was not satisfied to work in this blind rule-of-thumb

fashion—he wanted to know the reasons of things; so he kept picking up some knowledge of mathematics to help him understand his business. In the summer he was busy with carpenter work, but in the winter he generally went home. He did the chores on the farm in the early morning and at night, and went to school besides. As he learned more he decided to study and become an architect. He managed to spend one winter in Norfolk, Conn., under the instruction of the Principal of the Norfolk Academy. There he went through algebra and six books of geometry.

When he was twenty-five years old he had saved a little money from his carpenter work. Through the New York Tribune he saw that there was a college at McGrawville, N. Y., where a young man could earn his living and get an education at the same time. He decided to go to this college. So in the summer of 1854 he set out for Central College, as it was called. When he got there he found it was a very different place from what he had expected. It was open to both sexes and all colors, and was the gathering place of a queer set of cranks of all sorts. The teaching was poor, but still to the green country youth the experience was of immense value. His views were broadened and changed. He stayed at the college only a year and a half. In that time he went through algebra, geometry, and trigonometry, and studied some French and Latin. He soon proved himself to be by far the best mathematician in the college.

One of the students was a young woman named Angeline Stickney. She was a country girl of great sensibility and of fine mental qualities. She was working her way through college, and as a senior she helped in the teaching. Asaph Hall was one of her pupils in mathematics. Many were the problems he and his classmates contrived to puzzle their teacher, but they never were successful. When she was graduated Asaph Hall was engaged to her. He decided that he had stayed long enough at McGrawville. His money was about gone, and the college was poor. So in 1855 they set out together for Wisconsin. Angeline Stickney had a brother there, and she stayed at his house while Asaph tramped about the country in search of a school where they could teach. No school was open for them. They became tired of the flat, sickly country, and when spring came they decided to leave. On the 31st of March, 1856, they were married. Then they started for Ann Arbor. Asaph entered the sophomore and junior classes in Ann Arbor University, studying mathematics and astronomy under Prof. Brünnow. He found he could do good work in both these branches. His teacher encouraged him greatly. It was from him that he acquired his taste for astronomy. Prof. Brünnow was an excellent teacher, but he had trouble with his classes, and

his work was so changed and broken up that young Hall decided to leave after he had been there but half a year.

He went with his wife to Shalersville, Ohio, and took charge of the academy there. They conducted it successfully for a year, paying off all their debts and buying themselves new clothes, of which they were much in need. When the school was over they had no idea where to turn next. Hall wanted to go back to Ann Arbor and study again, but there was a great storm on the lakes at that time and his wife would not go. So they started East. He had had an offer from Prof. Bond, who was in charge of the Harvard College Observatory, of three dollars a week as assistant. Finally, he decided to accept it. He visited his old home in the summer, and in the fall of 1857 he took his wife to Cambridge and began his career as an astronomer.

Very few young married men of this day would like to start in a profession at the age of twenty-nine on a salary of three dollars a week. But young Hall expected he would be able to pick up outside work. He thought he could pursue his study in mathematics under Prof. Benjamin Peirce, then at Harvard. So he entered on his new life full of hope. He took a couple of rooms on Concord Avenue, near the observatory, and began housekeeping. He soon found he could not carry out all his plans. There was some quarrel between Prof. Peirce and Prof. Bond, and he could not study with the former without offending his employer. He had to give up that plan. His work at the observatory required long hours, but he managed to study a little by himself. He studied mathematics and German at the same time by translating a German mathematical work. His little income was all eaten up by simply the room rent. In order to live he had to do outside work. By computing, making almanacs, and observing moon culminations he doubled his salary and managed to scrape along. His wife worked by his side faithfully, encouraging him, helping him in his studies, and doing all the housework with her own hands. Hall soon became a rapid, accurate, and skillful computer. Soon his employers saw how valuable he was, and they gradually increased his pay, till at last he drew a salary of six hundred dollars a year.

He stayed in the Cambridge Observatory till the year 1862. At that time the war had been going on for a year. The officers at the Naval Observatory at Washington had gone off into the service of either the North or the South. Men were needed to fill their places. Hall was recommended to fill a position there. It was a good opening. He went to Washington, passed an examination, and was offered a place. In the fall of 1862 he went down to Washington to begin his work. The city was then in a ferment. Many of the officeholders were from the South. All sorts of jealousies

and meanness were rife in the departments of the Government. But he kept out of all disputes and settled down quietly to his work.

On January 2, 1863, he was appointed a Professor of Mathematics in the United States Navy. After that his career was assured, for his position was for life. Starting as a farmer boy, then turning carpenter, pursuing mathematics with the idea of becoming an architect, finally he had found the best field for his labor in astronomy. Up to this time his struggle was a hard one. He had never known what it was to have a moment of relaxation. It was toil from morning till night, and all that he did was for the personal benefit of others. After his appointment at Washington he was able to do work that counted for himself. So his public scientific career really began in 1862.

From 1862 to 1866 he worked on the nine-and-a-half-inch equatorial at the Naval Observatory under Mr. James Ferguson, making observations and reducing his work. One night, while he was working alone in the dome, the trap-door by which it was entered from below opened, and a tall, thin figure, crowned by a stovepipe hat, arose in the darkness. It turned out to be President Lincoln. He had come up from the White House with Secretary Stanton. He wanted to take a look at the heavens through the telescope. Prof. Hall showed him the various objects of interest, and finally turned the telescope on the half-full moon. The President looked at it a little while and went away. A few nights later the trap-door opened again, and the same figure appeared. He told Prof. Hall that after leaving the observatory he had looked at the moon, and it was wrong side up as he had seen it through the telescope. He was puzzled, and wanted to know the cause, so he had walked up from the White House alone. Prof. Hall explained to him how the lens of a telescope gives an inverted image, and President Lincoln went away satisfied.

After 1866 Prof. Hall worked as assistant on the prime vertical transit and the meridian circle. In 1867 he was put in charge of the meridian circle. From 1868 to 1875 he was in charge of the nine-and-a-half-inch equatorial, and from 1875 until his retirement on October 15, 1891, he was in charge of the twenty-six-inch equatorial. It can thus be seen that his practical experience as an observing astronomer has been long and varied.

During his stay at the observatory he was sent on several expeditions for the Government. In 1869 he was sent to Bering Strait on the ship Mohican to observe an eclipse of the sun. In those days one had to go to San Francisco by way of the Isthmus of Panama; all the instruments had to be sent the same way—so it was a big undertaking. In 1870–'71 he was sent to Sicily to observe another eclipse. In 1874 he went to Vladivostock, in Siberia,

to observe a transit of Venus. He visited China and Japan on the way. In 1878 he headed an expedition to Colorado to observe the eclipse of the sun, and in 1882 he took a party to Texas to observe another transit of Venus.

Although on these expeditions he did valuable service, it has been at Washington with the twenty-six-inch equatorial that he has done his most important work. He has made studies of many double stars, to determine their distances and motions. He has also given a great deal of time to the study of the planet Saturn. He made an especial investigation of the rings of this planet, and also discovered the motion of the line of apsides of Hyperion, one of Saturn's satellites. But by far the most important discovery he has made, the one that will connect his name with astronomy as long as the planets exist, was his discovery of the satellites of Mars. It had been thought by some old astronomer that perhaps Mars had satellites, but no one had been able to find them. In the fall of 1877 Mars was in a very favorable position to observe, and Prof. Hall turned his big telescope upon it. He searched night after night without finding anything new. He began to give up hope; but on the night of August 11th he discovered a little speck that turned out to be the outer satellite. Six days later he discovered the inner one. The discovery of these two little bodies (the smaller one being not more than fifteen miles in diameter) spread quickly among the observatories. The eager astronomers immediately began to find enough extra moons to supply another solar system. One observer insisted that there was one more moon at least, and Prof. Hall was blamed as stupid for not seeing it. But after a thorough investigation it was shown that Prof. Hall had discovered the two and the only two satellites of Mars.

This important discovery brought his name at once before the world at large, and was not slow in earning its reward. The Royal Astronomical Society presented him with a gold medal, and he was given the Lalande prize from Paris. Since that time his work has been recognized as it should. He has become a member of the most important scientific societies of this country, and an honorary member of the royal scientific societies of England and Russia and of the French Academy. The universities of the country have recognized his work, Yale and Harvard each giving him the degree of LL. D. The very last honor conferred upon him is the Arago medal, just awarded to him by the French Academy of Sciences.

Personally, Prof. Hall is a fine-looking man. He is tall and broad-shouldered. His forehead is high and deep. His eyes are clear and bright, in spite of years spent in gazing at the stars. He has always been strong and healthy. He is fond of the open

air, and has always taken exercise. So, in spite of his long years of hard work, he is now in perfect health. His success has not changed him in the least. He is always ready to help those who want to learn anything from him.

His writings have appeared mainly in astronomical magazines and in the Government reports of the work done in the Naval Observatory. They are all the results of practical astronomical work, and are mostly of a technical character. Consequently, they are of little interest to general readers. He has often been asked to write something for popular reading, but up to this time he has never consented to do so, thinking that there is already enough of such literature.

Prof. Hall is a self-made man. His life has not been an easy one. Every bit of his education, every one of his successes, has been gained by his own hard work. It was a steady uphill pull from the time he was thirteen years old until his appointment at Washington. In his younger days he saw many hard times. During a large share of that part of his life he had only one good suit of clothes in his possession. He and his wife were obliged to save every penny. From his early training and from such experience his habits were formed. Naturally they are of the simplest kind. He does not care for the luxuries of modern life. The comforts of a plain home are all he wants. He still lives almost as simply as when he was earning three dollars a week under Prof. Bond. He has never cared for society merely for its own sake, but he has been prominent in scientific circles. He is a quiet man who never pushes himself forward; yet, when he has anything to say, people are glad to listen to it.

In his ideas on politics, science, and religion he is liberal and yet conservative—that is to say, he has no objection to letting other people have their own thoughts and live their own lives. He can see no reason why science and real religion can not be reconciled. His views on religion and politics are sound. He does not care, however, to have anything to do with politics. He hates its corruption, meanness, and party quarreling. He has always been a little conservative in his scientific life. He has never been led into wild theories of no value. His work has been solid, earnest, and thorough, and will last forever. He is a widely read man, fond of study. He loves his work; so now, since his retirement in 1891, he continues his studies and investigations. He lives a quiet, simple life at his home in Washington, still advancing the cause of astronomy.

CORRESPONDENCE.

FLYING.

Editor Popular Science Monthly:

I WAS much gratified to see that Dr. Le Conte's very able and interesting article upon flying, in one of your recent numbers, fully recognized the fact that mere air in motion, commonly known as "wind," and popularly supposed to be in most cases moving at a uniform velocity, can not in the long run help a bird or a man to fly. In view of the large amount of foolishness published in the newspapers about rising in the air by the action of the wind, and the strong contrast that is drawn between wind and still air, it would seem probable that the writers in their rôle of would-be scientists base their doctrine upon the analogy of a rising kite. For the proper "squelching" of these notions their fallacy should be thoroughly exposed, and the real facts set forth as frequently as possible.

There is no question but that the apparent mysteries of rising, soaring, etc., without propulsive action, are due, as has been stated, to variations in air velocity rather than to that velocity itself. These variations can, of course, act only in conjunction with inertia. The bird or other flying machine, drifting with the air at its average speed, takes advantage of the inherent tendency of his mass to maintain its present rate of motion (whether positive or negative or *nil* in relation to the earth's surface) for a short time after the air velocity has changed, thereby lifting him up by some local body of air with, say, a suddenly increased velocity, acting as a wedge beneath the front of his wings (or other aëroplane) while he temporarily stays still, or nearly so, in reference to the general body of the air. Should there be a local decrease of velocity the conditions would be equivalent to a "breeze astern," and the rear edge of his wings would have to be elevated at an angle with the plane of the wind's motion—that is, if he wished to continue rising. All this is obviously upon the same principle as a block lifted by a wedge slid under it, which can be pushed up so long as it moves forward against the wedge or remains stationary or moves backward with the wedge, but at a slower rate of speed.

If the bird was so fortunate as to be held with the earth against the motion of the wind by a guy-line, after the manner of a kite, or if the block was held from a retrograding motion by a line in front or by a strut behind it, the matter would of course be perfectly simple; but it must be strongly impressed upon the popular mind that there is in the case of flying creatures no such holding action except that due to inertia, the which can last but a short time. We must therefore assume frequent changes of air velocity to account for the soaring which we so frequently see materialized as an actual fact. Going back to the analogy of the wedge, a very simple experiment will show that the block can be raised much higher by striking the wedge a quick blow, thereby taking a very full advantage of the inertia of the block, than it can when the wedge is pushed in slowly. If too slowly, its action will of course be *nil*, and the block will move back with it instead of rising.

Now it is obvious that we all of us know little enough about the principles of flying, but the first fact to be thoroughly impressed upon the mind of any would-be student of this subject is that wind, regarded usually as air in motion, must be considered as air at rest, and the earth as a moving body sliding along underneath it. Of course, this motion of the earth will make a difference to our future flying machines in regard to the time required to get from one place to another, according to its direction; but as far as the operations of propelling, soaring, etc., are concerned, the idea of wind must be left entirely out of the question except so far as we can learn about and deal with its frequent and rapid variations in velocity. It is probable, however, that these are too uncertain to depend upon, and our mechanical efforts must be directed toward getting any desired motion we wish in a medium of air at rest. The item of wind has therefore, as before stated, nothing whatever to do with the subject except as regards certain difficulties in stopping and starting from the surface of the earth and the time, with a given power, required to traverse given distances thereupon. OBERLIN SMITH.

BRIDGETON, N. J., *July*, 1894.

A REMONSTRANCE.

Editor Popular Science Monthly:

DEAR SIR: In your August number it was apparently claimed that the specialty of women, as women, is their power of intuition. But what is intuition? Dictionaries and general usage seem to make the word synonymous with instinct.

Now it is not so long since it was generally insisted that animals could never reason, but acted by instinct only; and in spite of much talk about "God-given instinct," the talkers actually, and not always secretly, considered their theory as a firm ground for despising animals as unintelligent.

At present, thinkers seem to acknowledge that animals can and do reason; and scientific men cease giving instinct as a cause for the conduct of animals. Will these thinkers now put women on a lower level than animals, or do they limit the word "reasoning" to slow action of the mind, and refuse it as a term for quick mental action? That were strange!

As a woman, I have seen much of women. I have yet to find one with real powers of intuition. I will not call her impossible. Instead, I encounter foolish women, who act from prejudice or impatience; wise women, who base their actions on great quantities of observations continually renewed and compared, as constant and careful as those of an accomplished detective; and a variety of women between these types. But—so absurd is the human being under the sway of conventionality—some of the wise actually made themselves believe that they acted and judged by intuition, because they had been told that women did so.

Furthermore, kindness may not require much reasoning power in the kind person, nor may mere abstention from vice in the abstainer; but I have always found that active goodness—and what other sort deserves the name of good?—needed reason to be brought into play as much as feeling.

ELIZABETH WINTHROP JOHNSON.

EDITOR'S TABLE.

ANOTHER RAID ON THE DOCTRINE OF EVOLUTION.

A FEW months ago we referred to the objections which had been made to the teaching of modern scientific views in the University of California; but fortunately we were able to state that much public sympathy had been extended to the incriminated professors, and that they were able to hold their positions without any curtailment of the liberty they claimed of imparting the best scientific instruction in their power without regard to preconceived notions or theories. Even as we wrote there was similar trouble brewing, though we were not aware of it, in the University of Texas. The results in the latter case, if we are rightly informed, have been far less satisfactory than in the former. The Texan conscience, it seems, is a very tender one; and when it became mooted that Dr. Edwards, the Adjunct Professor of Biology, was teaching on evolutionary lines, and that the ingenuous youths who attended his classes were in danger of imbibing such ideas as that the world may not really have been made in six days, and that the countless species of plant and animal life now existing or that have existed in the past may not have been called separately into being by so many distinct acts of creation, there was much heart-searching on the ranches, and an enlightened public opinion determined that something must be done at once. They can stand a good many things down in the Lone Star State, but heterodoxy and horse-stealing are two things they will not stand if they can help it. As the Austin Daily Statesman elegantly expressed it: "The mind of the common people of Texas is wonderfully set and united on the verity of the old Bible as she stands in the King James version. The least hint that anything is being taught in any school that will unsettle the faith of their children in the good old Bible doctrine of the creation of matter, the origin of life, and the descent of the race from Adam and Eve, without going any further back in the pedigree, will raise the 'Old Henry' and wake the reptile that sleeps on the log in the sun with pious fathers and mothers all over the State. The origin of man, as set forth in the Bible in a pretty clear fashion, is made in the image of God with a natural body and a reasonable soul. It was a creative act of almighty power immediately performed with no intermediate ancestry."

The slight literary defects which the

above extract—given, of course, textually—may reveal do not impair the lucidity with which it sets forth the views of "the common people of Texas." Whether Dr. Edwards had or had not heard of "the reptile that sleeps on the log with pious fathers and mothers all over the State" we are not informed. All we know is that, intentionally or unintentionally, he roused it from its slumbers, and that it was not long in stinging into action the regents of the university. A three-years' engagement had been entered into with the professor, only a short part of which had expired; but under the attacks of "the reptile" the regents made short work of their contract, and sent Dr. Edwards to teach his evolutionary doctrines elsewhere. It is rumored, indeed, that another reptile was roused into life at the same time as the orthodox one—namely, the reptile of local jealousy. The professor was not a Texan, and this, added to the fact that he was an avowed evolutionist, caused him to receive a very short shrift. One or two other professors, according to the journal above quoted, took the hint and, with a wisdom somewhat resembling that of Colonel Crockett's coon, "came down"—that is to say, resigned—so that at this date the university may claim to be tolerably free from the leaven of evolutionary theories.

Perhaps it is best. Texas is a remote State, and many things there are in a very primitive condition. It is a land where one man's opinion is as good as another's, and where any little defects in a gentleman's logic can be handily repaired with a six-shooter. According to the Daily Statesman, which ought to know whereof it affirms, "the common people" do not look upon schools and universities as places where some things may be taught of which they are themselves ignorant, but as places the instruction in which they are entirely competent and entitled, in the fullness of their knowledge, to direct. *They* know how the different forms of organic life came into existence, and no professor—particularly one from another State—is going to steal into their institutions of learning (save the mark!) and teach anything on this subject contrary to what they hold. Well, we think there is something in Mr. Spencer's works which fits this case. He says, in the preface to the Data of Ethics, that evil results may flow if people take up evolutionary views before they are really fitted for self-guidance. For some communities and individuals of a backward type the strong, not to say, coarse sanctions of a primitive theology are better and safer than the broader but less potent motives which the scientific view of the world and of human life affords. We are therefore by no means disposed to hold that the Texans do not know what is good for them. With a little change of dialect they might say with Tennyson's Northern Farmer:

> "Doctors, they knaws nowt, for a says what's naways true;
> Naw sort o' koind o' use to saäy the things that a do."

And just as the northern farmer had had his pint of ale every night for forty years, and insisted on having it still in spite of doctors, so "pious fathers and mothers all over the State" have been accustomed to the biblical version of the origin of species, and will have it in spite of all new knowledge and all improved theories. There is no great harm in this so long as the thing is thoroughly understood. We sympathize with Prof. Edwards in the disappointment which the untimely termination of his engagement doubtless caused him; but if any other trained biologist accepts a situation in the University of Texas it will be his own fault. The simple truth is that biological science can not as yet be taught in that State—at least not under the auspices of the State. Well, biological science can wait until the quarantine against it is raised, which, of course, it will be some day. The suf-

ferer meanwhile is the State, which condemns its young men either to listen to antiquated and utterly inadequate discussions of biological questions in the State university or else to go abroad for the knowledge which is denied at home.

THE AMERICAN ASSOCIATION IN BROOKLYN.

THE American Association had a very pleasant and profitable meeting in Brooklyn. That city has a peculiar character among American towns of great size in being a city of homes rather than of business, and is the residence of a large number of liberal-minded, public-spirited men, and of women warmly interested in everything tending to promote advance in knowledge and the means of right living. The scientific students of the country could not fail to find themselves at once at home among such people. This feature of the social and intellectual life of the place was well presented by Dr. Backus in his address of welcome to the association, when, referring to the fact that the citizens had failed to secure the great university of which they had dreamed, he intimated that they had a more than abundant compensation in the great private high schools of world-wide reputation, generously supported by the public without governmental or municipal aid, and appropriating their annual surplus revenues to the strengthening of their faculties and equipments; besides supporting the largest free high schools for young men and for young women in the world, and possessing as superstructures on the private foundations of generous benefactors an institution furnishing "the most practical, the most extensive, and the most advanced system of industrial instruction to be found in our country," and another which maintained twenty-six departments of original scientific research. Dr. Brinton replied in behalf of the association, that it recognized and appreciated the advantages of a reunion in a city "whose streets are lined with edifices erected by the munificence of a few for the benefit of the many, and which in so many features testifies to the broad liberality and enlightened intelligence of its foremost citizens."

Dr. Brinton in his address described the association as a body cultivating a science the spirit of which is to seek as its goal truth, "the one test of which is that it will bear clear and untrammeled investigation"; which admits and appeals to no other evidence than "that which it is in the power of every one to judge, and which is absolutely open to the world, having about it no such thing as "an inner secret, a mysterious gnosis"; a science at once modest in its own claims and liberal to the claims of others, and "noble, inspiring, consolatory" in its mission, "lifting the mind above the gross contacts of life, presenting aims which are at once practical, humanitarian, and spiritually elevating." Dr. Harkness, the retiring president, chose as his subject the magnitude of the Solar System and the elements which enter into the determination of it. His address, while it contained much matter of great interest, was largely technical, dealing considerably with mathematical discussion, and is hardly susceptible of being presented in popular form.

The vice-presidential addresses, likewise, tended to be technical. Dr. Franz Boaz discussed the relation of Race Faculties to the Advancement of Civilization, maintaining that too much emphasis has been laid upon them at the expense of the environment, which is also a factor of very great importance. Vice-President G. C. Comstock addressed Section A upon Binary Stars. Prof. Mansfield Merriam, in the Section of Mechanical Science and Engineering, considered the Resistance of Materials under Impact. In his address upon a Stable Monetary Standard, Vice-President Farquhar, in the Section of Eco-

nomic Science and Statistics, favored the abandonment of attempts to establish a legal tender by legislation, and the leaving of the question to settle itself. The Battle with Fire was the subject of an address by Vice-President Norton's before the Chemical Section, which embodied an account of the contributions which chemistry has made to the art of extinguishing fires and of preventing them, and contained many practical hints. In the other sections, Vice-President Samuel Calvin described the Niobrara stage of the Upper Cretaceous; Prof. W. A. Rogers spoke of obscure heat as an agent in producing expansion and contraction of metals; and Prof. L. M. Underwood discussed the evolution of the *Hepaticæ*. While a large proportion of the papers read in the sections were technical and limited in their bearing, a considerable number were also of great general interest.

The meetings of the affiliated societies attracted nearly as much interest as those of the association itself, and papers were read in them which were, to say the least, equal in merit and importance to the average of those which were read in the association. We regard these societies as still in the experimental stage; and it appears to be yet to be determined whether their influence as a whole will be beneficial or the contrary to the general body.

Amendments to the Constitution were proposed for consideration next year, to admit libraries and societies to representation in the association through one of their officers, and to add a Section of Sociology.

The members of the association enjoyed the full measure of the social exchanges and festivities which attend the body wherever it goes. Excursions were made to many points of scientific interest. There were some features to be criticised about the meeting. The relatively small attendance at the very interesting lectures of M. Du Chaillu and Prof. Cope was hardly creditable to the citizens of Brooklyn, in whose honor they were especially given. A deficiency of provisions for the comfort of the attendants of the meetings, particularly in the matter of directions for finding the way, was complained of; and imperfections in the arrangements of some of the excursions revealed a want of adequate central control.

LITERARY NOTICES.

AN INTRODUCTION TO THE PHILOSOPHY OF HERBERT SPENCER. By WILLIAM HENRY HUDSON. New York: D. Appleton & Co. Pp. 234.

THIS book is largely an outgrowth of lectures delivered from time to time on Mr. Spencer's Philosophy. The book itself was undertaken to meet what seemed a healthy popular demand. Mr. Hudson had observed with some surprise the widespread diffusion of interest in the subject of evolution. His lectures were heard by attentive and appreciative audiences, and cultivated men and women, especially the younger ones, expressed the desire to know more of the new thought and of its bearing upon the practical problems and issues of the day. He could not refer all inquirers to Mr. Spencer's works; for, clear and forcible as is the presentation in them all, they are too voluminous and the style of their writing is too condensed for any but persons having abundant time and strong powers of concentration to master them in bulk. Therefore the author has undertaken to furnish this introduction as a sort of guide or handbook to the complete works, by the aid of which readers may gain a kind of bird's-eye view of the system as a whole, or, if they are disposed and able to examine it more in detail, may be assisted in their course through its different regions. In this he has succeeded admirably, and his book is marked throughout by a clearness of statement which will enable any one of average intelligence to follow the author through even the most abstruse parts of the discussion. The examination of Mr. Spencer's work is preceded by a biographical sketch of the philosopher —the most satisfactory and probably the only full one that has been presented. In it

all the incidents which had a part in shaping Mr. Spencer's career, and in directing his thoughts to the course they took, are plainly set down, with the several stages in the development of his scheme, and the order in which its different parts were conceived or brought forth. Two chapters are then devoted to Mr. Spencer's earlier work—to the preparation for the Synthetic Philosophy—and to the Synthetic Philosophy itself. Here pains are taken to place in its proper light Mr. Spencer's connection with the modern doctrine of evolution, and to show him to be the originator of it—antedating Darwin and all others many years in the conception and first publishing of it, as we have often shown in the Monthly. These chapters deal to a considerable extent with the abstract and metaphysical aspects of Mr. Spencer's work, but only as a necessary introduction to what is to follow; for it is not the author's purpose to consider the philosophy as an abstract conception or a piece of metaphysical rationalistics, but rather to demonstrate it as a scheme of life and of reigning natural law; and he does this with a success that is nothing less than remarkable. This is, in fact, one of the most important characteristics of the volume. No pains are spared to make prominent the practical element in Mr. Spencer's philosophy, to exhibit the bearing of his writings on current problems, and to show how the system fits to all the various relations of the world's growth and the exigencies and duties of life. Of all men's, Spencer's thought has been most potent in shaping and directing the intellectual movement of the latter half of the century; and it has been so by reason of the immediate bearing of his teachings not only on the everyday questions that occupy men's minds, but also on those larger problems which are pressing on all sides for solution. Every man of whatever calling or aim who reads them attentively will find in them what will aid him in the pursuit of his profession or his object. This bearing appears throughout in Mr. Hudson's book, and especially in the chapters on the Spencerian sociology and on the ethical system and the religious aspect, not because of efforts to exhibit it—for such efforts are wholly absent—but logically and naturally, as a part of the thing itself. Mr. Hudson is at some pains to explain the exact meaning of Mr. Spencer's "Unknowable," and to correct the impressions that have been industriously cultivated by prejudiced antagonists that he is a materialist or an agnostic in any atheistic sense; a pains which is supererogatory as to persons who will carefully read what Mr. Spencer says, but may be necessary as to those who come to his writings burdened with the endless reiteration of misrepresentations. Those who read this little book can hardly fail to be impressed with the great importance and wholesome character of Mr. Spencer's writings, and to desire to know more of them.

FOLK TALES OF ANGOLA. Fifty Tales, with Ki-Mbundu Text, Literal English Translation, Introduction, and Notes. Collected and edited by HELI CHATELAIN. Boston and New York: Houghton, Mifflin & Co., for the American Folklore Society. Pp. 315, with Map. Price, $3.

THE author visited Africa as pioneer and linguist of Bishop Taylor's self-supporting missions. In his studies of the native language he found that all the dialects spoken at Loanda and Angola and those of the adjoining districts formed one language, and that that language—the Ki-Mbundu—was worthy of the founding of a literature. He published some elementary books in it, and by the aid of an intelligent native was able to take down a large number of folk tales, riddles, songs, and proverbs, of which the present volume is only a first installment of what he intends to publish. After comparing the whole material, the author has found that many of the myths, favorite types or characters, and peculiar incidents which have been called universal, can also be traced through Africa from sea to sea, and that African folklore is not a tree by itself, but a branch of one universal tree. Though Portuguese and Arabian influence is evident in many of the stories, still the bulk of the tales is purely native. African folklore is especially rich in animal stories or fables. The folklore of the Bantu appears to be remarkably homogeneous and compact, while the Nigritic folklore, after the exotic elements connected with Islam are eliminated from it, is found to be virtually the same. The mythologies and superstitions of the various tribes are easily reducible to one

common type, and this is strikingly similar to the popular conceptions of the Aryans and other great races when not identical with them. The stories are classified as traditional stories regarded as fictitious; stories reported as true, or anecdotes; historical narratives; stories of moral philosophy, or proverbs; poetry and music, and riddles. The myths and tales of the negroes in America are all derived from African prototypes, and through the American negro have exercised a deep and wide influence on the folklore of the Indians, and even of the American white race. This fact gives strong incentives to the study of the subject by Americans. Besides the stories, an analysis is given of their general features, a bibliography, directions for the pronunciation of Ki-Mbundu, a description of the country and people, and copious illustrative notes.

REPORT OF THE COMMISSIONER OF EDUCATION FOR THE YEAR 1890–'91. Washington: Government Printing Office. Two volumes. Pp. 1549.

THE whole number of pupils in schools of all grades, public and private, is given at 14,669,069, constituting 23·09 per cent, or not quite one fourth, of all the population. Besides these are to be counted pupils in evening schools, art, industrial, and business schools, schools for defective classes and for Indians, in all about 300,000 pupils, which would swell the whole number to nearly 15,000,000. The commissioner remarks upon a correspondence between the waves of industrial prosperity and depression that pass over the country and the relative attendance upon the private and the public schools. The whole number of teachers in schools of both kinds is nearly 425,000. The entire expenditure during the year for public schools was $146,800,163, or $17.67 for each pupil attending 135·7 days, and $2.31 per capita of the whole population. Of the income for schools nearly seventy per cent comes from local taxes and nineteen per cent from State taxes. Besides these and other statistics of the schools in the United States, the first volume of the report gives papers on Secondary Education in New Zealand; Education in France; a review of the Educational Systems of England and Scotland and their Operations for 1890–'91; the Educational System of Ireland; Industrial and Technical Education in Central Europe, Education in Russia, Japan, Italy, Corea, and Hawaii; Legal Education in the United States and in Canada, Australia, Spanish America, Japan, and China; Colleges of Agriculture and the Mechanic Arts. The second volume gives a "Name Register" of State and City Educational Officers; statistics of city, secondary, higher, and professional schools; papers on Education in Alaska, the Education of the Colored Race, Class Intervals in City Public Schools, Educational Statistics, discussions of current educational questions, a report on the physical and mental condition of 50,000 London school children, and Facilities in Experimental Psychology in the Colleges of the United States. These articles are followed by statistical tables.

SCIENCE AND HEBREW TRADITION. By THOMAS H. HUXLEY. Collected Essays, Vol. IV. New York: D. Appleton & Co. Pp. 372. Price, $1.25.

THE essays contained in this volume are concerned mainly with the question whether the Old Testament is wholly true or partly legendary. The first three, however, have no direct connection with those that follow. They deal with the discoveries and inductions of paleontology, and can be said to bear upon the above question only by furnishing samples of the scientific method of research. They include Prof. Huxley's lectures on evolution delivered in New York in 1876, and his lecture on the Method of Zadig. The fourth essay of the volume, entitled The Interpreters of Genesis and the Interpreters of Nature, was written for a controversy with Mr. Gladstone upon the correctness of the account of creation in the book of Genesis. The one following—Mr. Gladstone and Genesis—is a continuation of the same theme. In both of them Prof. Huxley denies that the order in which the several kinds of living creatures are said to have been created is the same as that revealed in the records of paleontology. In the next two essays he gives the facts which conflict with the story of the Noachian Deluge. The last in the volume is A Study of the Evolution of Theology, the data for which are drawn from the practices of the ancient Israelites and of certain Polynesian tribes.

Believing that all claims to infallibility

are pernicious, Prof. Huxley states in his preface that these essays are intended to combat certain of such claims. "Unless I greatly err," he says, "the arguments adduced go a long way to prove that the accounts of the Creation and the Deluge in the Hebrew Scriptures are mere legends; and, further, that the evidence for the existence and activity of a demonic world, implicitly and explicitly inculcated throughout the Christian Scriptures, and universally held by the primitive churches, is totally inadequate to justify the expression of belief in it. This much on the negative side of the discussion. On the positive side, the essay on the Evolution of Theology, as I imagine, shows cause for the conclusion that the Israelitic religion, in the earliest phase of which anything is really known, is neither more nor less rational, neither better nor worse ethically, than the religions of other nations in a similar state of civilization; that in the natural course of its evolution it reached, in the prophetic age, an elevation and an ethical purity which have never been surpassed, and that, since the new birth of the prophetic spirit, in the first century of our era, the course of Christian dogmatic development, along its main lines, has been essentially retrogressive."

It will thus be seen that Prof. Huxley aims to be not a destroyer but a purifier of religion.

ELEMENTARY LESSONS IN STEAM MACHINERY AND THE MARINE STEAM ENGINE. With a Short Description of the Construction of a Battle Ship. By Staff-Engineer J. LANGMAID and Engineer H. GAINSFORD. New York: Macmillan & Co. Pp. 267. Price, $2.

THESE lessons, prepared for the naval cadets in one of the vessels of her Majesty's fleet, are intended to represent a systematic course of simple instruction preparatory to a more thorough study of the whole subject. In the earlier lessons instruction is given in the elements of construction and mechanism, and in those mechanical details which students are usually expected to learn by workshop experience. The conclusions given are wholly such as have been arrived at by experience, and the various details of marine engines are illustrated by the simplest examples. The lessons on Construction include the principles of measurements, the uses and qualities of the metals used, and instructions concerning riveted joints, screw threads and fastenings, transmission of power by shafts, etc.; conversion of motion, toothed gearing, friction, stuffing boxes and packing, joints of pipes, etc.; valves and cocks, and pumps. The lessons on the marine steam engine relate to boilers and boiler mountings and engines, with the details similarly separately considered.

AËRO-THERAPEUTICS; OR, THE TREATMENT OF LUNG DISEASES BY CLIMATE. With an Address on the High Altitudes of Colorado. By CHARLES THEODORE WILLIAMS. New York: Macmillan & Co. Pp. 187. Price, $2.

THIS work, by the Senior Physician in the Hospital for Consumption and Diseases of the Chest, Brompton, and late President of the Royal Meteorological Society, consists of the Lumleian Lectures for 1893, delivered before the College of Physicians. In his lectures the author has attempted to sketch a scientific system of aëro-therapeutics, based on the combination of modern meteorology with clinical experiment, in which each element of climate is duly considered in its bearing on health and disease. The lectures severally relate to the factors and elements of climate, temperature and moisture, and barometric pressure in its relation to health and disease. In the summary of results of different climates compared, at the close of the regular lectures, a marked preponderance is found in favor of high altitudes as against the English home stations, the Riviera, and sea voyages. The address on the high altitudes of Colorado embodies a clear account of the character and climate of the country, and a strong appreciation of its value to health.

THE CONQUEST OF DEATH. By ABBOT KINNEY. New York. Pp. 259.

THE author is struck with the deficiency of children in American families and the apparent prevalence of the habit of limiting the number of children, and forebodes disaster from it. "For some twenty years," he says, "fact after fact has forced upon me the reluctantly received opinion that the present vital movement in our population can only eventuate in the elimination of the old American stock through nonreproduction. It is impossible to disguise the fact that in many

places the population is maintained or increased by immigration, or by the children of recent immigrants. The fidelity of these to the duties of marriage is largely due not to the reason but to useful superstition. Intellectual inquiry invites infidelity. Skepticism has no soul, nor has it breeding power. Man must have a belief to be in earnest. The skeptics disappear, the superstitious survive, but progress can not live without intellectual activity. This is incompatible with the infallibility demanded for the integrity of superstition. So long as there is progress there must be intellectual independence. Here, then, is the dilemma—skepticism and sterility, or superstition and stagnation; progress to extermination, or perpetuation of life without improvement. This problem, and others kindred to it, are those for which I have sought a solution." Finally, the main motive of the work is declared to be the necessity of reproduction in man to enter any demonstrable future. The subjects of Sex, Marriage, Husband Choice, Wife Choice, The Child, Hints to the Husband, A Word to the Wife, and Religion, are discussed.

THE THEORY OF HEAT. By THOMAS PRESTON. New York: Macmillan & Co. Pp. 719.

THE author's object in preparing this volume has been to treat the science of heat in a comprehensive manner, so as to produce a tolerably complete account of the whole subject in its experimental as well as in its theoretical aspect. He has consequently enjoyed a freedom in his choice of subject-matter and mode of exposition which would not have been possible in a work designed to meet the requirements of some particular class of persons preparing for examinations or engaged in practical pursuits. The nobler aspect of science as an instrument of education and culture is kept in mind throughout, and the principle is enforced that an acquaintance with a number of facts does not constitute a scientific education, and there is no royal road to learning other than that by which it is pursued for its own sake. The most fruitful method of exposition, it is observed, is not necessarily that by which a given number of facts may be recorded in the shortest space, but rather that by which they may be most easily assimilated by the mind and most comprehensively grasped in their general bearings and mutual relations; and this is the method which is most calculated to advance knowledge and raise the intellectual character of the individual. The historical method of treatment is preferred, as admitting the most constant comparison of theory with the results of experiment and the closest scrutiny at every step of the development. With this is combined a due amount of detail in description and explanation to secure instruction and such suggestion and criticism as may excite intellectual life and independent thought on the part of the student. The classical experiments are given in detail, and in addition such other investigations are noticed as will give the student a general idea of the work that has been done in each department up to the present time. In the introductory chapter, or "preliminary sketch," some remarks are given on the general effects of heat and on the meaning of the terms used in the subject, the theories of heat are reviewed, and the subjects of matter and energy and the theories concerning them are discussed. In the subsequent chapters, thermometry, dilatation, calorimetry, change of state, radiation and absorption, conduction, and thermodynamics are considered. Such subjects as the steam engine and the theory of solutions are omitted, as having obtained separate treatment in special works. The kinetic theory of gases has been entered into so far as to meet the immediate requirements of the subject in hand; and the suggestion is made that it, with some other subjects usually dealt with in treatises on heat, are deserving of treatment in a separate volume.

SCIENCE AND CHRISTIAN TRADITION. By THOMAS H. HUXLEY. Collected Essays, Vol. V. New York: D. Appleton & Co. Pp. 419. Price, $1.25.

THIS volume contains ten of Prof. Huxley's vigorous magazine articles, first published in the years 1887 to 1891, to which is prefixed the Prologue to his volume entitled Controverted Questions. Among these essays are his series of three on agnosticism, and his two on the Gadarene swine miracle in controversy with Mr. Gladstone, while the others deal mainly with other miracles of the New Testament. In the essay on The Value of Witness to the Miraculous, Prof. Huxley scrutinizes certain mediæval miracles

recorded by Eginhard, a writer of the time of Charlemagne; and in the one on Possibilities and Impossibilities he examines the two accounts of the feeding of multitudes with a few loaves and fishes. The somewhat extended preface to this volume includes an argument against the demonology, or belief in various kinds of evil spirits, which has been made a part of Christian theology. It includes also a statement of the "Synoptic Problem"—i. e., the question as to how, when, and by whom the gospels which bear the names respectively of Matthew, Mark, Luke, and John were written. In looking back over his various discussions of theological doctrines, Prof. Huxley declines to admit the charge that he has "gone out of his way" to attack the Bible; "and I as steadfastly deny," he continues, "that 'hatred of Christianity' is a feeling with which I have any acquaintance. There are very few things which I find it permissible to hate; and though it may be that some of the organizations which arrogate to themselves the Christian name have richly earned a place in the category of hateful things, that ought to have nothing to do with one's estimation of the religion which they have perverted and disfigured out of all likeness to the original."

The subject of *Helical Gears* is not a very familiar one, but it appears to be of such growing importance as to warrant a special treatise upon it. In preparing his volume, *A Foreman Pattern-maker* has treated with much detail of illustration the true and only workable methods of development of spur and bevel wheels, and has entered fully into the proper methods of construction of the pattern parts. He has also explained the methods of molding these gears by machine. He has aimed to make his book practical and adapted to the shop and the technical school. (Published by Macmillan & Co., at the price of $1.)

George M. Dawson, in his *Geological Notes on some of the Coasts and Islands of Bering Sea and Vicinity*, notices as one of the most remarkable features of the region the absence of any traces of a general glaciation. Respecting the latest changes in elevation of the land, evidences of a recent slight general uplift are mentioned as visible in several widely separated places. Mr. Dawson also sends us *Notes on the Geology of Middleton Island, Alaska*. Both these papers are published in the Bulletin of the Geological Society of America.

Hugh M. Smith, M. D., reprints from the Bulletin of the United States Fish Commission *Economic and Natural History Notes on Fishes of the Northern Coast of New Jersey*, and a paper on *The Fyke Nets and Fyke-net Fisheries of the United States*, with notes on the fyke nets of other countries. In the former paper the subject of Ocean Pound Fishing is dealt with.

The function of dynamics in evolution is discussed by *John A. Ryder* in a lecture delivered by him in August, 1893, at Woods Hole Biological Laboratory on *Dynamical Evolution*. The author concludes that observers have hitherto allowed purely morphological considerations to becloud their vision; and that when each of the five sciences—physics, chemistry, physiology, morphology, and psychology—"shall have been given its due weight and place in the conduct of the study of life-forms, we shall begin to know what the latter really means, but not till then." (Published by Ginn & Co., Boston.)

J. W. Spencer, State Geologist, publishes as a part of his work *The Palæozoic Group—Ten Counties of Northwestern Georgia* (Polk, Floyd, Barton, Gordon, Murray, Whitfield, Catoosa, Chattooga, Walker, and Dade Counties), embracing the Geological and Physical Characteristics, Economic Geology, and Soils. A chapter on Good Roads is incorporated in the report, and the whole is illustrated by a geological map.

A part, including numbers six to twelve of Vol. VII of the *Annals of the New York Academy of Sciences*, contains Coleopteriological Notices, by T. L. Casey; A Revision of the American Ciclidæ, by C. H. Eigenmann and W. L. Bray; Notes on some South American Fishes, by C. H. Eigenmann; and The Granite at Mounts Adam and Eve, Warwick, Orange County, N. Y., and some of its Contact Phenomena, by J. F. Kemp and Arthur Hollick.

In a paper on *The Widening Use of Compressed Air*, applications of this force are mentioned by *W. P. Pressinger* in the work of the pneumatic dynamite gun; in pneumatic block signaling; to raising water

from deep wells; to spraying oil into petroleum furnaces: as a stirrer, cooler, etc., in various chemical manufacturing processes; in pneumatic elevators, cranes, and hoisting machinery; in pneumatic transmission tubes; in refrigerating and ventilating; in the propulsion of cars; in the purification of water supplies; and in various other operations in which compressed air appears as a power, "ever ready to do our bidding, summoned or dismissed by the simple turning of a valve."

In his *Contributions to the Morphology of Cladoselache* (Cladodus)—a fossil shark—considerable attention is given by *Bashford Dean*, of Columbia College, to the development of the fins and of the heterocercal structure. (Published by Ginn & Co., Boston.)

The Eighth Annual Report of the Commissioner of Labor—for 1892—relates to industrial education, and comprises the results of inquiries on the subject made at home and abroad. The schedule of questions under which the information was obtained covered a wide scope, and included such topics as the age of the student workman, the occupations he had followed, the nature of his previous training, his proficiency in the use of tools and material, whether he attained an average degree of skill and efficiency in the use of tools quicker than those who had not had manual or trade training, whether he had acquired greater economy in the use of materials, whether he was more proficient in the things that indicate mental cultivation, whether he promised to become a more intelligent workman, whether he received better compensation than persons not coming from the technical schools, and many other points. In its original work the department has received the aid of several men—experts and specialists—not generally employed by it, to whom acknowledgment is made by name. *Carroll D. Wright*, Commissioner.

Number 4 of Volume V of *Studies from the Biological Laboratory of Johns Hopkins University* contains four papers. The first and most extended of these is an account of An Undescribed Acraniate: Asymmetron Lucayanum, by E. A. Andrews. The creature is a small lancelet found in the Bahamas. Maynard M. Metcalf furnishes for this number Contributions to the Embryology of Chiton, a first paper, and Dr. John P. Lotsy contributes the beginning of an opus on The Formation of the So-called Cypress Knees. The fourth paper is a brief statement on The Origin and Development of the Stichidia and Tetrasporangia in Dasya Elegans, by B. W. Barton. The several papers are accompanied by plates and figures.

The sixth special report of the United States Commissioner of Labor, Hon. *Carroll D. Wright*, is an account of *The Phosphate Industry of the United States*. This industry is carried on in South Carolina and in Florida, having become established first in South Carolina, and extends somewhat into adjoining States. The report describes these two chief fields separately, giving the geology of each, an account of the methods and machinery employed in mining each of the several kinds of phosphate rock, statements of analyses, and general observations. There are also detailed statistics as to rates of wages, prices of machinery, royalties to the State in South Carolina, freight charges, and other elements in the cost of production, the quantities consumed in a term of years, etc. The report is illustrated with several photographic views and diagrams, and two folded maps.

An article by *Arthur Hollick*, reprinted from the Bulletin of the Torrey Botanical Club, on *Additions to the Palæobotany of the Cretaceous Formation on Long Island*, describes forty-six species of plants (leaves) found in this formation, additional to the ten species described in a previous paper. Of these, nine species are new. An accompanying paper—*Some Further Notes on the Geology of the North Shore of Long Island*—embodies a discussion of the "preglacial" or "yellow gravel" of the district named, and its probable relation to the cretaceous of New Jersey.

At an educational conference on geography held in Chicago in December, 1892, *W. M. Davis*, *C. F. King*, and *G. L. Collie* were appointed to prepare a selected list of topographical maps published by the various Government bureaus, making special mention of such sheets as might best illustrate the physical features of our country. It was desired that the list should be distributed among school superintendents and teachers as an aid in securing for the high schools the specified maps, together with the map of

the district in which the school is situated, to be introduced in the teaching of geology. The list thus contemplated is published, with brief commentaries pointing out the significance of the several maps, by Henry Holt & Co., in the pamphlet, *The Use of Government Maps in Schools.* It describes sixty-eight maps. (Price, 30 cents.)

Mathematical students of the higher branches will understand and appreciate *Alexander Macfarlane's* setting forth of *The Principles of Elliptic and Hyperbolic Analysis.* In it the fundamental theorem of trigonometry is investigated for the sphere, the ellipsoid of revolution, and the general ellipsoid; then for the equilateral hyperboloid of two sheets, the equilateral hyperboloid of one sheet, and the general hyperboloid. Subsequently, the principles arrived at are applied to find the complete form of other theorems in spherical trigonometry, and to deduce the generalized theorems for the ellipsoid and the hyperboloid. At the end, the analogues of the rotation theorem are deduced. (Author's address, Austin, Texas.)

A paper by *J. F. Kemp* in the Contributions from the Geological Department of Columbia College, on *Gabbros on the Western Shore of Lake Champlain*, deals with certain igneous rock in the townships of the district named in which the most important phases of the great igneous body that forms the bulk of the Adirondacks are illustrated and photographic details not previously noted are adduced. The paper also appears in the Bulletin of the Geological Society of America.

The first number of *Tufts College Studies* comes without an editor's name, but a footnote to one of the articles, apparently editorial, bears the name of J. S. Kingsley. The number contains three papers—viz., The Anterior Cranial Nerves of Pipa, by G. A. Arnold; Ectodermic Origin of the Cartilages of the Head, by Julian B. Platt; and The Classification of the Arthropoda, by J. S. Kingsley. (Published at Tufts College, Mass.)

In *Observations on the Geology and Botany of Martha's Vineyard* (contributions from the Geological Department of Columbia College) the question is discussed by *Arthur Hollick* whether the island has been subjected to distortion and elevation by mountain-building forces, or whether its existence may be accounted for upon the same hypothesis by which we may account for the other islands—Long and Staten—as remains of the glacial morainal fringe. The author's conclusions are in favor of the latter hypothesis. The botanical section of the paper gives a list of a hundred and twenty-eight plants found growing on the island.

The *Ore Deposits at Franklin Furnace and Ogdensburg, N. J.*, are carefully described in a paper on that subject by *J. F. Kemp*, as to their history, location, surrounding, nature, and working. A list is given of sixty-six minerals occurring in them. The paper is a contribution from the Geological Department of Columbia College.

The object of the original edition of Mr. *H. W. Watson's Treatise on the Kinetic Theory of Gases* (Macmillan & Co., $1) was to set forth in a more systematic and in some cases a more simple form the demonstrations of the laws of the theory. In the present (the second) edition substantially the same ground is covered as in that one; but a more detailed treatment has been adopted, partly on account of historical interest, but mainly to avoid some of the difficulties experienced by the student in following out investigations of the great generality required in a more condensed treatment.

The matter of *Elements of Solid Geometry* (Macmillan & Co., $1.60) was used by the author, *N. F. Dupuis*, in annual courses of lectures to mathematical students, who were much interested. The subject is carried somewhat further than is usual in ordinary text-books of plane and solid geometry. The work is divided into four parts, which are again subdivided: 1. Dealing with the descriptive properties of lines and planes in space, of the polyhedra, cone, cylinder, and sphere. 2. Dealing with areal relations. 3. Stereometry and planimetry; and 4. The principles of conical or perspective projection. A collection of miscellaneous exercises is presented at the close of the work. The author expresses a high opinion of the value of synthetical solid geometry, in that it exercises the intellectual powers in the development of the theorems, the imagination in the building up of the spatial figures, and the eye and the hand in their representation.

White's Manual, in his *New Course of Art Instruction for the Fifth-Year Grade*,

includes the outline of the year's work in geometrical drawing—including sections on measurement, geometry, working drawings, development, decorative drawing, color, historic ornament, design, paper cutting, and model and object drawing. It is marked by the good qualities characteristic of all the books of this series. (American Book Company.)

A new volume of *Statistics of Public Libraries*, compiled by *Weston Flint*, has been issued by the Bureau of Education. It contains a list of three thousand eight hundred and four libraries in the United States having over one thousand volumes, arranged by States. Many of them are not what is commonly understood as public libraries, for they belong to schools, societies, and corporations, and a few are even set down as private. With each are given statistics concerning its age, size, income, growth, manner of use, ownership, etc. Prefixed to the list are summaries of these various statistics illustrated by comparative diagrams. A statistical list of public libraries in Canada is appended.

An edition, abridged for the use of junior students, of Baron *Roger de Guimps's Pestalozzi, his Aim and Work*, is published by C. W. Bardeen, Syracuse, N. Y., in his Standard Teachers' Library. The translation is by Margaret Cuthbertson Crombie, who has also appended brief, suggestive notes and a bibliography of Pestalozzi. (Price, 50 cents.)

The Art of Living in Australia would not be misnamed were it called The Art of Living Everywhere. It is, in fact, a treatise on hygiene and diet, by *Philip E. Muskett*, intended especially for Australia, but embodying principles that are generally applicable. Its main object is to call attention to the need of improvement in the food habits of Australians, who, the author is impressed, are living in special opposition to their semitropical environment. They are consumers of butcher's meat enormously in excess of any common-sense requirements and beyond any other people, while their fisheries are not developed, market gardening is "deplorably neglected," salads are "conspicuous by their absence," and Australian wine is "almost a curiosity." All this, he thinks, is wrong, and he tries to teach a better way. The Australians are not the only people who need instruction or admonitions on these subjects. In addition to the discussion of the principles of right living — including adaptation to the climate, ablution, bedroom ventilation, clothing, diet, and exercise—the book contains three hundred Australian cookery recipes and accessory kitchen information, prepared by an expert in such matters. (London: Eyre & Spottiswoode.)

In *Primary Elections* a study of methods for improving the Bases of Party Organization is presented by *Daniel S. Remsen*. Believing that reform should begin at the primary, the author would have the rules or laws of party aim to induce the largest participation of party members at that meeting. A method should also be provided which would enable minorities to elect their due proportion of delegates. Holding these principles in view, rules and methods are suggested which, while they may not be perfect, are believed to be on the right lines and such as will tend to make candidates feel responsible to the membership of their party rather than to any central power. (New York: G. P. Putnam's Sons' Questions of the Day Series. Price, 75 cents.)

John Phin dedicates his *Common-Sense Currency*—a practical treatise on money in its relation to national wealth and prosperity—to the farmers and mechanics of the United States, in the hope that the principle it sets forth may help them to detect the sophistries and avoid the traps of cheap-money demagogues, of avaricious and dishonest legislators who sell themselves to class legislation intending to cheat the workingman; and fanatics, honest, perhaps, but ignorant and enthusiastic, whose wild schemes contradict the fundamental principles of monetary science. (New York: Industrial Publication Company.)

The Diseases of Personality and *The Psychology of Attention*, two well-known and valuable works by the eminent French psychologist, *Th. Ribot*, are published by the Open Court Publishing Company, Chicago, as numbers 4 and 5 of their Religion of Science Library, at 95 cents each.

In a paper on *The Coming Railroad*, the Chase-Kirchner aërodromic system of transportation is described and its merits are set forth by the projectors, *G. N. Chase*

and *H. W. Kirchner*. The system includes an elevated track, with aëroplane sails as one of the sources of motor power. (St. Louis, Mo.)

Parts VIII and IX of *H. H. Bancroft's Book of the Fair* are devoted to the Woman's Exhibits, the Children's Department, and the Machinery and Agricultural Halls. (The Bancroft Company, Chicago. Price, $1 each.)

Entolai may be characterized as a "philosophical romance," or as a life history, with a religious element, described otherwise by the author, *A. M. Bourland*, as a letter to those he loves about science and the ideal. Its purport may be conceived from the dedication: "To those whose love of Nature has so thoroughly possessed them that they have been able to escape from every vestige of superstition, and as a consequence of which have embraced an unfaltering faith in the loving confidence in righteousness, that sustains all things, and rejoices in all truth." (Van Buren, Ark.: Lloyd Garrison.)

From Earth's Center: A Polar Gateway Message, is the title of a story embodying a thinly disguised teaching of some of the doctrines of the Edward Bellamy school, by *S. Byron Welcome*. A country within the earth, reached by means of a polar current, is supposed, where the ideal prevails of the conditions imagined by the dreamers of the class we have referred to.

Among recent bulletins of the United States Geological Survey is a *Report of Work done in the Division of Chemistry and Physics*, for 1890–'91, by *Frank W. Clarke*, which is occupied mainly with analyses of minerals and meteorites. Another bulletin is a *Record of North American Geology for 1890*, by *Nelson H. Darton*, being an alphabetical author and subject bibliography of books and essays in periodicals, dealing with North American geology, and received by the Survey in 1890. Works on general geological subjects, if printed in North America, are also included. *Samuel H. Scudder* describes in another bulletin, with three plates, *Some Insects of Special Interest from Florissant, Colorado*. Still another is a record of *Earthquakes in California in 1890 and 1891*, by *Edward S. Holden*. It consists of an observation of each shock made at the Lick Observatory, together with brief descriptions from many city and country newspapers in various parts of the State.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Alabama: Experiments in Crossing Cottons. Pp. 48, with Plates.—Delaware: Strawberries. Pp. 10.—Massachusetts: Analyses of Commercial Fertilizers. Pp. 8.—New York: On Legal Standard for Cheese. Pp. 20.—Preventing Leaf Blight. Pp. 6.—North Dakota: Weather and Crop Service for June, 1894. Pp 15.

Bendire, Charles. Nests and Eggs of New Birds from Island near Madagascar. Pp. 3.

Binet, Alfred. Psychologie des Grands Calculateurs et Joueurs d'Echecs (Psychology of Great Calculators and Chess Players). Paris: Hachette & Cie. Pp. 361.

Bird, Charles. Geology. A Manual for Students in Advanced Classes, and for General Readers. New York: Longmans, Green & Co. Pp. 429. $2.25.

Brinton, D. G. The "Nation" as an Element in Anthropology. Pp. 16.—On Various Supposed Relations between the American and Asian Races. Pp. 16.—The Alphabets of the Berbers. Pp. 11.

Call, R. E. On the Geographic and Hypsometric Distribution of North American Viviparidæ. Pp. 12, with Map.

Carus, Dr. Paul. The Nature of the State. Chicago: The Open Court Publishing Company. Pp. 56. 25 cents.

Cooke, Ebenezer, Editor. Pestalozzi's How Nature Teaches her Children. Syracuse, N. Y.: C. W. Bardeen. Pp. 206. $1.50.

Dall, William H. Monograph of the Genus Gnathodon, Gray. Washington: United States National Museum. Pp. 18, with Plate.

Dean, Lee Parker. The Evolution of Worlds from Nebulæ. Bridgeport, Conn.: The Marigold Printing Company. Pp. 84.

Earl, Alfred. Practical Lessons in Physical Measurement. New York: Macmillan & Co. Pp. 350. $1.25.

Farrington, Oliver C. An Analysis of Jadeite from Mogoung, Burma. Pp. 3.

Fewkes, J. Walter. A Study of Certain Figures in a Maya Codex. Reprint from the American Anthropologist. Pp. 16, with Plates.

Frankland, Dr. and Mrs. Percy. Micro-organisms in Water. New York: Longmans, Green & Co. Pp. 532. $5.

Frost, Edwin Brant, Translator and Editor. Dr. J. Scheiner's Treatise on Astronomical Spectroscopy. Boston: Ginn & Co. Pp. 482, with Plates. $5.

Gebhard, William Paul. On Testing House Drains and Plumbing Work. Pp. 8.—The Relations between Gas Companies and Gas Consumers. Pp. 7.—Artificial Illumination. Pp. 8.

Gill, Theodore. The Nomenclature of the Family Poecilidæ or Cyprinodontidæ. Pp. 2.—The Differential Characters of the Salmonidæ and Thymallidæ. Pp. 6.—The Relations and Nomenclature of Stizostidion or Lucioperca. Pp. 6.—The Nomenclature and Characteristics of the Lampreys. Pp. 4. All United States National Museum, Washington.

Houston, Edwin J. A Dictionary of Electrical Words New York: The W. J. Johnston Company, Limited. Pp. 669. $5.

Hudson, William Henry. An Introduction to the Philosophy of Herbert Spencer. New York: D. Appleton & Co. Pp. 234. $1.25.

Huxley, Thomas H. Discourses, Biological and Geological. New York: D. Appleton & Co. Pp. 388. $1.25.

Japan, Imperial University of. Journal of the College of Science. Vol. VI, Part IV. Pp. 156, with Plates Vol. VII, Part I. Pp. 110, with Plates. Tokyo.

Johnson, General Bradley T. General Washington. New York: D. Appleton & Co. Pp. 338.

Jordan, David Starr. Factors in Organic Evolution. Leland Stanford Junior University, Palo Alto, Cal. Pp. 149.

Knowlton, F H. A Review of the Fossil Flora of Alaska. Washington: United States National Museum. Pp. 36, with Plate.

Le Conte, Joseph. Memoir of John Le Conte. Berkeley, Cal. Pp. 24.

Mearns, Edgar A., M. D. Description of a New Species of Cotton Rat from New Mexico. United States National Museum. Pp. 2.

Merrill, George P. On the Formation of Stalactites and Gypsum Incrustations in Caves. Pp. 5, with Plates.—The Formation of Sandstone Concretions. Pp. 2, with Plate.

Michigan Mining School. Reports of the Director, 1890-'92. Pp. 102.

The New Science Review. Quarterly. Vol. I, No. 1, July, 1894. Philadelphia: The Transatlantic Publishing Company. Pp. 128. 50 cents. $2 a year.

New York Society of Pedagogy. Magazine and Book Reference. Quarterly. March and June, 1894. Pp. 8 and 10.

New York State Board of Charities. Twenty-seventh Annual Report. Pp. 651.

Otken, Charles H. The Ills of the South. New York: G. P. Putnam's Sons. Pp. 277.

Pammel, Prof. L. H. A Lecture on the Pollination of Flowers. Des Moines, Iowa. Pp. 57.

Paret, T. Dankin. Emery and other Abrasives. Philadelphia. Pp 36.

Pennsylvania, University of. Contributions from the Zoölogical Laboratory. Philadelphia. Pp. 68.

Rathbun, Mary J. Notes on Crabs of the Family Inachidæ. Pp. 32.—Crabs (New Species) from the Antillean Region. Pp. 4. United States National Museum.

Riley, C. V. Social Insects from the Psychical and Evolutional Points of View. Biological Society of Washington. Pp. 74.

Salazar, A. E. Qarta al Senor Presidente de la Société Scientific du Chile sobre Ortografia Razional (Letter on Rational Orthography). Santiago. Pp. 18.

Senate, United States, Committee of Finance. Replies to Tariff Inquiries: Cotton Manufactures. Washington. Pp. 127.

Senn, N., M. D. Abdominal Surgery on the Battlefield. Pp. 15.

Sexton, Pliny T. A Plan for Independent Voting within Political Party Lines. Pp. 16.

Shufeldt, R. W. On Cases of Complete Fibulæ in Existing Birds. Pp. 6.—On the Affinities of the Steganopodes. Pp. 3.

Simonds, Frederic W. A Reply to some Statements in Prof. Tarr's "Lake Cayuga a Rock Basin." Pp. 5.

Sloane, Florence N. Practical Lessons in Fractions by the Inductive Method. Boston: D. C. Heath & Co. Pp. 92, with Charts. 40 cents.

Small, Albion W., and Vincent, George E. An Introduction to the Study of Society. American Book Company. Pp. 184. $1.80.

Spurr, J. Edward. The Iron-bearing Rocks of the Mesabi Range in Minnesota. Minneapolis: Harrison & Smith. Pp. 259.

Stearns, Robert E. C. Shells of Certain California Localities. United States National Museum. Pp 64.

Stejneger, Leonhard. Notes on a Japanese Species of Reed Warbler. United States National Museum. Pp. 2.

Stewart, D. D., M. D. Reactions of Nucleo-Albumin with Urinary Tests. Pp. 29.

Thomas, Allen C. A History of the United States. Boston: D. C. Heath & Co. Pp. 482. $1.25.

Thornton, John. Human Physiology. New York: Longmans, Green & Co. Pp. 436. $1.50.

True, Frederick W. Notes on Skeletons and Skulls of Porpoises. Washington: United States National Museum. Pp. 5.

United States: Summary Statement of the Imports and Exports for June, 1894. Washington: Government Printing Office. Pp. 108.

Veeder, M. A., M. D. Solar Electrical Energy not Transmitted by Radiation. Rochester, N. Y.: Academy of Sciences. Pp. 10.

Welch, William H., M. D. Higher Medical Education and the Need of its Endowment. Pp. 24.

White, Charles A. Notes on the Invertebrate Fauna of the Dakota Formation. United States National Museum. Pp. 6, with Plate.

Williamson, Benjamin. Introduction to the Mathematical Theory of the Stress and Strain of Elastic Solids. New York: Longmans, Green & Co. Pp. 135. $1.50.

Wright, Claude Galla. An Outline of the Principles of Modern Theosophy. New York: The Path, 144 Madison Avenue. Boston: New England Theosophical Corporation. Pp. 192. $1.

Yale University. Report of the Observatory. Pp. 20.

Ybarra, A. M. Fernandez de, M. D. The Medical History of Christopher Columbus. Pp. 16.

Zahm, the Rev. J. A. Bible, Science, and Faith. Baltimore: John Murphy & Co. Pp. 116. $1.25.

POPULAR MISCELLANY.

Spermophiles.—The destructive animals that form the subject of Vernon Bailey's Bulletin (Department of Agriculture) on the prairie ground squirrels of the Mississippi Valley, belong to the genus *Spermophilus*, and are commonly known as spermophiles. The name is derived from the Greek words *σπέρμα*, seed, and *φιλεῖν*, to love, in allusion to the fact that seeds form a large proportion of the food of the species. In the Old World the spermophiles are known as souslicks, while in America they are popularly called gophers or ground squirrels. The term gopher, however, belongs properly to a very different group of animals, to which it should be restricted, namely, the pocket gophers, which have external cheek pouches, and resemble the moles in living under ground and throwing up little mounds along the courses of their subterranean tunnels. Ground squirrel is a less objectionable name, because these animals really are ground squirrels; the term is, however, commonly applied to the chipmunks belonging to the related genus *Tamias*. *Spermophilus* is a

large genus, and is found throughout the greater portion of the north temperate region of both hemispheres from eastern Europe across northern Asia and over the western two thirds of America. About thirty-five species and subspecies are found in the United States, most of which are restricted to the arid and subarid region west of the Rocky Mountains. Throughout their range, wherever the land is under cultivation, they are among the most destructive of mammals, feeding on grain, fruit, and garden vegetables to such an extent that the losses from their depredations must be counted in hundreds of thousands of dollars. Several States have paid large bounties for their destruction, without materially reducing their numbers; and numerous bulletins of agricultural experiment stations have dealt with means of destroying them. Prof. C. P. Gillette has shown, from examination of their stomachs, that the thirteen-striped spermophile is not an unmixed evil, for, besides large quantities of grain, it eats numbers of grasshoppers, wireworms, and other noxious insects, whence he concludes that a large proportion of its food is made up of insects that seem to consist almost exclusively of injurious species, and adds that "the squirrels would be a most valuable adjunct to any cornfield after planting if some method could be devised to prevent them from taking the corn."

Pin Wells and Rag Bushes.—A paper on Pin Wells and Rag Bushes was read in the British Association by Mr. E. Sidney Hartland. Prof. Rhys has lately brought together a number of instances, in Wales and the Isle of Man, in which persons frequenting sacred wells for the cure of disease and other purposes have been in the habit of throwing pins into the water, stuffing rags under stones, or tying rags upon adjacent trees; and he has discussed the reasons for these practices, suggesting that the pins are offerings and the rags are vehicles for the transfer of the disease. These suggestions were discussed in Mr. Hartland's paper, who compared the practices mentioned by Prof. Rhys with ancient and modern observances in Europe and other parts of the world at sacred wells, crosses, trees, temples, and other objects of superstition. He preferred the hypothesis that the object of these usages was to effect unison between the worshiper and the divinity, which was to be effected by the perpetual contact with the god of some article identified with the worshiper. Prof. Sayce mentioned evidences of similar customs in Palestine and Egypt. In the latter country the rags were hung up by the Bedouin and not by the native fellaheen. Colonel Godwin Austen said that throughout the Himalayas, from Cashmere to far in the East, in Bhotan, he had observed the custom of placing rags upon cairns, especially at the passes. Dr. Robert Mensal, president of the section, said that, although the customs mentioned in the paper might seem ridiculous, they all had a meaning, and the science of folklore, as interpreted by men like Mr. Hartland, was enabling us to find out what that meaning was.

Plants and their Seasons.—The philosophy that underlies the association of certain groups and types of plants with certain definite seasons of the year is the subject of a study by Henry L. Clarke, of the University of Chicago, the flora east of the Rocky Mountains alone being considered. The problem is defined: "From March to November, each month brings a new prospect in field and forest, and every careful observer can feel in this succession of forms a harmony into which any decided change would break discordantly. . . . To say that the fall flowers are not the spring flowers or those of summer are neither, merely because they have chosen at random this season or that, is neither science nor common sense. The truth is forced upon us that the various groups of flowering plants are not scattered indiscriminately from one end of the season to the other, but are regulated by definite scientific principles; and that just as relations can be traced between physical geography and geographical distribution, or between plant history and geological periods, so there is a connection between the relations of season to season and the relations of their respective floras." After a careful examination of the phenomena in detail, Mr. Clarke deduces the conclusion that "from early spring to late autumn there is a progression in the general character of the flower groups, from the lower to the higher, successive groups succeeding each other in time, paral-

lel groups coming synchronously. And the later in order may be types of a character of development, or they may be specializations of a group whose normal forms belonged to an earlier season. In their blooming season the more perfect succeed the more simple; the aberrant, the normal; the specialized, the generalized. But with the general observation arise certain modifying conditions" —which are mentioned.

Unsanitary Positions.—In a paper on Some Derangements of the Heart and Stomach produced by the Unusual Position of Children in School, read before the Académie de Médecine of Paris, Dr. Motais pointed out the effects of that attitude in which the pupil seats himself on the ischial tuberosity, supporting himself by leaning on the left elbow and stooping forward, so that the trunk of the body then develops an antero-lateral curvature. The result is, firstly, that by the lateral inclination the border of the false ribs on the left side descends until it is in contact with the iliac crest. The larger curvature of the stomach is thus pressed upon the spleen and general mass of the intestines; secondly, by bending the body so much anteriorly a fold is formed at the upper part of the abdominal wall, and the anterior surface of the stomach follows the curve. These conditions produce a mechanical hindrance to the movements of the cardiac stomach. The function of the thoracic viscera is equally interfered with by means of the anterior curvature owing to the drawing together of the ribs and also by the descent of the left half of the diaphragm toward the upper border of the stomach. The difficulty thus afforded to respiration reacts on the heart, the contractions of which are, moreover, mechanically hindered by the distortion of the thoracic cavity. The neck is necessarily somewhat twisted, and the large vessels at the root, therefore, are submitted to a certain amount of torsion. The effect of the attitude described above is especially marked when an organic affection of the heart exists. Dr. Motais is also of the opinion that this position is a strong pathogenic element protracting the duration of dyspepsia. He has found that if children who suffer from this complaint are made to assume a correct posture while in school the symptoms subside more rapidly than when such a precaution is not taken. The same observations are applicable to adults engaged in sedentary occupations, and Dr. Motais laid great stress on the point that the medical man, when treating cases of chronic heart or gastric disease, should give his patients directions as to the posture to be assumed when much sitting is necessary.

Australian Dingoes.—A colony of dingoes or Australian wild dogs recently bred in the *Jardin d'Acclimatation* in Paris, and two of the brood of four lived. This animal has very dense hair, which is thicker in winter than in summer, erect and mobile ears, long and pointed muzzle, and tufted tail, which hangs down when the animal is at rest and is carried curled over the back when its attention is attracted by any noise. It has well-developed senses of hearing and smell. Its average height is perhaps about twenty inches, but different specimens vary greatly in size. Its hair is usually red on the back and head, growing lighter and lighter on the inside of the thighs and limbs. Some individuals are of uniform color; others have white on the paws and the end of the tail. The dingo inhabits the forests, heather, and steppes of the whole Australian continent, where it lives upon kangaroos and whatever other animals offer to its greedy appetite; and it plays havoc with the flocks of the colonists, who war upon it without mercy. Dingoes are frequently domesticated, but, according to Bohm, they retain all their wild instincts in that condition, and readily attack any animal that comes within reach of them. The two puppies in the Jardin d'Acclimatation were cared for with much solicitude by their mother, who did not leave them, but permitted the attendants to change their litter and handle them without objection. She refused all food but raw meat, but occasionally drank milk. She played freely with the other dogs around the kennel, some of which were of fine breeds; and when any conflict arose with regard to food, knew perfectly well how to defend herself. When the young were a month old, the mother, finding they did not require her constant attention, gave way to her vagabond habits. She made her way out of the box in which the little ones were confined, and

left them to wander around the garden, only returning to give them suck She at length escaped from the garden to Neuilly, but returned of her own accord. For fear of losing her entirely, she was separated from her young and fastened up. The young are very familiar, and play all day long with the other young dogs.

Thrifty Birds.—A curious illustration of the industrial instincts of animals, given in M. Frédéric Houssay's book on that subject, is afforded by the California woodpecker, which, though an insect eater, stores away for its winter supply food of an entirely different character, not so subject to decay. It collects acorns, for which it hollows small holes in a tree—a hole for an acorn—into which the acorn is exactly fitted, ready to be split by the strong beak of its owner, but too tightly held to be stolen by other birds or squirrels. Another woodpecker, in Mexico, stores against droughts, selecting the hollow stem of a species of aloe, the bore of which is just large enough to hold a nut. It drills holes at intervals in the stem and fills it from bottom to top with nuts, the separate holes being probably made for convenience of access to the column of nuts within. The common ants of Italy store oats and other kinds of grain in chambers which they make of about the size of a watch. They have a way of keeping the grains from sprouting with which we are not acquainted; and if they are removed, the seeds sprout. When they wish to use their store, they allow the grains to germinate till the chemical change takes place in the material that makes its fermenting juice suitable for their digestion. They then arrest the process of change by destroying the sprout, and use the stock of glutinous sugar and starch as their main food in winter.

Atmospheric Dust and Air Colors.—Having continued his observations on dust particles in the atmosphere in connection with other meteorological phenomena, Mr. John Aitken has now exceeding fifteen hundred observations, to produce which required the testing of fifteen thousand samples of air. The list includes, besides Great Britain, observations made in the south of France, at Hyères, Cannes, and Mentone, and at the Italian lakes. At none of the places in these districts was pure air ever met with. On the slopes of Monte Motterone, at Baveno, with the wind blowing up the slopes and carrying up the impure air, the amount of dust at two thousand feet was reduced only to 0·64 of the number at low level, while if the wind was from other directions it was reduced to 0·3. The conclusion that the descriptions given by many writers of the beauty of the coloring on earth and sky seen at high level at sunrise and sunset are much exaggerated is confirmed by the observations on the Rigi Kulm. During five years no coloring at sunrise or sunset was witnessed from this point equal to what is frequently seen at low level. The sunset colors are shown to depend very much on the amount of dust in the air. When the atmosphere is comparatively free from dust the coloring is cold, but the lighting is clear and sharp; and when there is much dust, there is more color on the mountains and clouds and in the air itself, and the coloring is warmer and softer. At high level the coloring is more feeble and of shorter duration. A thick veil of haze seemed to hang in the air between the observer and the mountain on all days when the number of particles was great, and it became very faint when the number was small. The condition of the air on the occasions of the different visits to the Rigi varied greatly. The clearest days, with the lowest numbers of particles, were when the wind blew from the Alps. The daily maximum on the Rigi did not appear on all days. Winds from pure directions generally prevented it, either by checking the ascent of the valley air, or by the valley air being pure, or by the pure valley air not being much heated by the sun and therefore having but little tendency to rise. It was very marked when the wind was from the plains. The hour at which the rise in numbers began and the hour of maximum were very irregular. The amount of the daily maximum varied greatly; sometimes it was only two or three times the morning number, while it at other times exceeded it eightfold. In the observations at Kingairloch, in Argyllshire, certain abnormal readings of dust particles were always accompanied by certain conditions of weather. If the sky remained clouded all day, the numbers were always low during the whole of

the day; but if breaks formed in the clouds, the numbers began to rise, and the increase was very much in proportion to the amount of clear sky. It also appeared that these abnormal readings came more frequently with anticyclonic than with cyclonic circulation. The fact that during the days of abnormally high readings the air did not become hazed to anything like the extent indicated by the number of particles, seemed to suggest that these nuclei are of molecular dimensions, and it is even possible they may not be nuclei at all while the air is dry, and form nuclei in saturated air. The Kingairloch observations, when arranged in tables, showed that nearly double the number of particles are required to produce the same amount of haze when the air is very dry as when it is damp. The transparency of the air was also noticed to be roughly proportional to the wet bulb depression. It is not the amount of vapor in the air that produces this effect, but the nearness of the vapor to the dew point, which seems to enable the dust particles to condense more vapor by surface attraction and otherwise, whereby, by becoming larger, they have a greater hazing effect. In all densely inhabited areas the air loses its purity, and in all uninhabited areas it tends to regain it; but all uninhabited areas are not equally good purifying ones. Much of the dusty impurity discharged into our atmosphere from artificial sources, by volcanoes, and by the disintegration of meteoric matter, falls to the ground, but much of it is so fine it will hardly settle. The deposition of vapor on these small particles seems to be the method adopted by Nature for cleansing them away; they become centers of cloud particles and ultimately fall with the rain.

The Labors of a Woodpecker.—John B. Smith, of Rutgers College, New Jersey, writes to Garden and Forest that he has received a piece of white oak, thirteen inches in length and three inches in diameter, containing four holes made by a woodpecker. Each of the holes is nearly or quite an inch wide with the grain, and a trifle less across the grain, narrowing to the bottom of the holes; each of them reaches into the center of the tree and into an insect burrow. In order to reach one of the larvæ which were the object of its researches, the bird was compelled to make two attempts, having missed the point on the first attempt. The larva for which all this work was done measured about three quarters of an inch in length, with a diameter of perhaps one sixteenth of an inch, and would hardly serve to make more than a scant mouthful for even the smallest woodpecker. It must have taken the bird at least half an hour of persistent work to make each hole, or at least an hour to secure this one larva, weighing only a few grains. It seems, Mr. Smith remarks, as if it would be almost impossible to gain from such a larva a fair return in food value for the energy expended in getting at it, especially where it is necessary to make two efforts to recover one mouthful. In the other burrows the bird was more successful, and gained the larva at the first attempt.

A Forest in Nicaragua.—With the exception of a few clearings, the entire region of the San Juan River, Nicaragua, is described by B. Shimek, in his report to the Natural History Society of the State University of Iowa, as covered with typical tropical forests. They are almost impenetrable, except with the aid of the *machete*, with which the traveler must literally tunnel his way in many places through the walls of vegetation. The trees, many of which are very tall and from eight to fourteen feet in diameter, are not quite so closely placed together as those of our northern forests; but the intervening spaces are covered with shrubs and vines and numerous other plants, so that, particularly in lower places, dense jungles are formed. Moreover, each tree is a veritable garden in itself. The masses of parasites and epiphytes which cover the larger branches of the trees, and often extend down the trunk and along the smaller branches to their very tips, form a perfect canopy overhead through which the sun's rays never penetrate. Ferns, bromelias, orchids, mosses, and many other plants crowd their hosts with a dense mass of multicolored vegetation. In their active struggle for existence with more powerful neighbors of the forests, these plants have probably gradually ascended, in their search for the sun's light, to the upper branches of the very neighbors which sought to crowd them out, thus transferring the struggle from the surface of the soil to the air above. So firmly

is this habit fixed, however, that, even where a tree stands alone, its trunks and branches are almost invariably covered with these plants. Their abundance and variety may be judged from the fact that upon a single jicara tree, not more than twenty feet high, which stood in a clearing near Castillo, the author counted forty species of epiphytes. The vines and underbrush are less abundant on the higher grounds, and moving about is consequently easier. But, whether the place is high or low, the same deep, dark, reeking forest spreads over all. Two facts strike the observer as peculiar, at least during the season which the party spent at Castillo—the comparative scarcity of brilliant flowers, and the failure of the plants of one species to mass together. The comparatively small number of conspicuous flowers is a disappointment to him who expects to find a mass of brilliant bloom in these tropical forests; not so much because these flowers are really wanting as because the flowering period of most of the species is rather long, and for the further, perhaps more important, reason that the flowers which do appear seem insignificant when compared with the sea of green that covers everything. No less striking is the fact that, as a rule, specimens of any one species do not mass together to the exclusion of other species, excepting sometimes along the watercourses. Different kinds of trees are mingled together in endless confusion, and no "groves" of any one species, such as we are familiar with in the North, occur, nor can any species, as a rule, ever be said to be prominent. The same is true of smaller plants; and the collector is not only bewildered by the variety of plants that come in his way, even in a restricted locality, but is also provoked by the scarcity of specimens of most of the species. Along the river banks, however, palms, grasses, etc., often take possession of large tracts.

Origin of Clays.—Clay, says Mr. Robert T. Hill, in his report on that material in the "Mineral Resources of the United States," is the immediate or ultimate product of the decomposition of feldspar. Feldspar is a constituent mineral of all the igneous rocks of the earth, and is especially abundant in the older granites and gneisses. By its decomposition, which occurs principally under the action of water, the soda, lime, potash, and other alkaline constituents of the feldspar are removed in solution, leaving the aluminum silicate and quartz as a residuum, commercially known as rock kaolin—a non-plastic material which, when free from iron, is also known as porcelain clay. Water, in Nature as in pottery, is the chief agent in clay working, and, besides its original action in decomposing the feldspar, it transports and grinds the original kaolin, and deposits it, in various degrees of purity or mixture, in secondary localities as a sediment. Clay material thus produced is known as sedimentary or transported clay, and, with the exception of some of the kaolins which have not been far removed from their place of origin, is more or less plastic. The washing and grinding of clays by clay-workers is a repetition of fundamental geologic processes of erosion, corrosion, and deposition constantly going on in Nature; and the geologist can see in the flumes and settling tanks of the potter a laboratory demonstration of the principal agencies which he studies. The clay material resulting from the decay of feldspar may be broadly classified under the two general heads of residual and sedimentary. The residual material is that which is found in the original place of occurrence of the decomposing feldspar, and may possess many physical aspects, sometimes occurring as a firm or crumbling rock, resembling decomposed granite, or again as a fine, white, non-plastic clay or kaolin. It is usually accompanied by quartz, a material not essentially injurious, which can be removed, if that is desired, by washing. The sedimentary clays are those which have been removed from their place of origin and redeposited in water. They embrace all degrees of mixture and purity, and may be either kaolinitic or plastic.

Value of a Geological Survey.—On the 18th of April, 1894, the geological survey of Alabama attained its majority—twenty-one years—under the present management, with Eugene A. Smith as State Geologist. By way of memorial of the occasion maps are in course of preparation showing the condition of our knowledge of the geology of the State at the beginning and at the end of the period, 1873 to 1894; and besides these, tables showing the relative amounts of raw

materials and of finished products from the mineral resources of the State at the same times. A sketch of the history of the surveys in the State has also been prepared by Mr. Smith. They were begun with the appointment of Michael Tuomey as Professor of Geology in the State University in 1847, when he was expected to spend about four months in each year in field observations. The next year he was made State Geologist. An appropriation was first made for the survey in 1854. Prof. Tuomey died in 1857; his last reports were edited and brought out by Prof. John W. Mallet, chemist to the survey; and the survey was discontinued. The second survey, under Prof. Smith, was begun in 1873. A detailed account of its several stages and departments, with the papers published by it, is given in the memoir. The co-operation of the United States survey with the State survey, begun in 1879, is recognized as having been "very distinctly advantageous." "In retrospect one can, however," says Prof. Smith, "easily see how these benefits might have been materially increased by more frequent conferences and consequently more thorough mutual understandings and adjustments." The survey has cost during the past eleven years $75,847, or an average of about $6,900 a year. For the whole period of twenty-one years during which the survey has been active, the aggregate cost has been $90,597, an average of $4,314 per annum. Since the organization of the survey, the tax rate of the State has been reduced over fifty per cent. without diminishing the revenues. The increase in the value of property in certain sections of the State that has rendered this possible has been due in the main to the development of the mineral wealth, and to this the survey publications have contributed a certain undetermined share. Some of the regions of the State in which the mining of coal and iron had since assumed vast proportions were untouched when the earlier reports directed attention by maps, analyses, and otherwise, to their great resources; and very recently the survey has demonstrated the existence of profitable areas in the coal measures heretofore untried; has pointed out a source of wealth in the phosphatic marls of certain sections; has shown that gold may be mined with profit at many points; has demonstrated that clays suitable for the manufacture of fine porcelain ware, fire brick, tiles, and other articles occur in practically limitless quantity in many sections; and has pointed out the places where good marbles and building stones may be had for the quarrying. All these have as yet not been turned to account.

Meanings of Japanese Fans.—The study of Japanese fans is regarded, in Mrs. Charlotte M. Salwey's book on the subject, as substantially the study of the history, religion, etiquette, daily manners and customs, peace and war, trade, games, and literature, in fact, of the whole civilization and art of the country. From the sixth century downward fans were a part of the national costume. Every fan belonging to every rank had its meaning, and was used in its own particular way according to a strict code of etiquette. The flat fan, or *uchiwa*, was introduced into Japan by the Chinese, and has been made in different shapes and used in many different ways. The cheapest and most usual forms are common objects in the West. One of its most curious varieties is the iron war fan, invented in the eleventh century for the use of military commanders, either for direction and signaling or as a shield for defense. It is made of leather and iron. The water fans are made of bamboo and thinly lacquered, so that they may be dipped in water to secure extra coolness while fanning. Another kind of *uchiwa* is the revolving white fan, which whirls around its stick and can be rolled up. Another strong, flat paper fan is used as bellows to blow the charcoal fire in the kitchen. The *agi* are folding fans; among them the *hi* wood fans are the most beautiful. They are painted with flowers and tied with white silk. Anciently they were hung with artificial flowers made of silk. These were the court fans, and different flowers were appropriated by different great families, so that a fan answered the purpose of armorial bearings. Folding fans also served the purpose of ensigns in war, and an enormous fan, *mita agi*, giant fan, was carried in processions in honor of the sun goddess. Children and dolls have fans of their own. Dancers and jugglers carry peculiar fans. The tea fan,

Rikiu, was used at the ancient tea ceremony for handing little cakes. The *agi* is now frequently made useful by being covered with engraved maps of the different provinces. Sometimes a fan case holds a dagger. Preachers make points in their speeches by sharply opening or shutting their white fans. Album fans, on which poems are written, are a curious feature in the life of Japan. Many old legends are told again by the arrangements of houses, flowers, figures, and birds painted on the faces of fans. An endless etiquette is involved in the use of fans. With the Japanese, in fact, the fan is an emblem of life. The rivet end is regarded as the starting point, and as the rays of the fan expand, so the road of life widens out toward a prosperous future. The *agi* is said to have originally taken its shape from the remarkable mountain Fusiyama, which represents to the Japanese all that is beautiful, high, and holy.

Artificial Birds for Women's Hats.—According to a writer in the London Spectator, a change has come over the minds of women in respect to feathers; and while these pretty ornaments continue to be worn, the objections to the wanton sacrifice of birds in order to procure them have so far prevailed that substitutes have been found for those kinds to obtain which birds were killed. While the egret plume—the finest of these feathers—is still unapproachable as an ornament, the milliners say that ladies object to buying the real article, "because it is cruel," and demand artificial substitutes, or are contented with less perfect plumes, and sham "ospreys," as they are called, are made in ways it is difficult to determine. Some are fashioned from split quill feathers of a larger heron. In others even a microscope fails to show the process of manufacture. Besides substitutes for the "osprey," "all kinds of composite feather decoration, perfect for the purposes to which it is applied, are now used for hats and bonnets, and a naturalist in a milliner's shop finds himself confronted with a hundred varieties of plumage never seen in Nature, but excellent in art, for which it would puzzle any one but the *plumassier* or the taxidermist to find a name. The era of stuffed birds and natural wings adorning headdresses is almost over. Not long ago, for instance, terns were a favorite ornament. The whole bird was used. Large hats were fashionable, and two or three of the 'sea swallows' were grouped on a single head. . . . Now the milliners have discovered a substitute with which no lover of birds can quarrel, and which reflects no little credit on their craft. Poultry feathers, in some cases of natural colors, but more often dyed to tints suited to the material with which they are worn, are made up into plumes, wings, coronets, and pompons, with a grace and variety of outline which harmonize with the modeling of the human head far better than the natural bird forms. Wings of domestic pigeons, often mottled with exquisite shades of gray or roan, are still used; but as the pigeons themselves are destined for food, no one can quarrel with the disposition made of their plumage. The greater part of modern head gear, however, is decorated with dyed cock feathers, or 'coque' feathers—pronounced to rhyme with 'oak'—as the milliners prefer to call them. The use of the cock's feathers has been a gradual development. In John Leech's day they were suggested by the plumes worn by the Sardinian troops in the Crimean War, and were worn in ladies' felt hats, somewhat of the 'field marshal's' pattern. These were only the dark-green tail feathers. But the piles of 'Mercury wings' of all colors—plain or decorated with tinsel or jet—which filled the milliners' shops last summer, and which still hold their own, are an immense advance on the cock-feather plumes. Some of these wings are so well made that, except for want of proportion between the primary and secondary feathers, even a naturalist's eye might be deceived. Regarded purely as an ornament, they are preferable to the natural arrangement, for their construction admits of endless adaptation." Women's fondness for feathers may be credited with being the means of preserving one and that the largest species of living bird from extinction, for it has offered the inducement for which ostrich farms have been established and are maintained.

The Australian Diprotodon.—Interest was excited in the recent meeting of the Australasian Association by an account, by C. W. de Vis, of the diprotodon, fossil bones of which have been found in Lake Mulligan,

and its times. The diprotodon was in some respects like a wombat, but seems to have been less capable of rapid motion. The spongy texture of the bones of the skeleton indicates that it frequented lakes and marshes. Two species of the fossil have been found in central Australia—one about six feet high and ten feet long, and the other about five feet high and eight feet long. The arid central plains of the present were occupied in diprotodon times by vast extents of luxuriant forest and richly vegetated districts, well watered by wide rivers. The marsupials were even then the dominant type of life in Australia; lizards were also numerous, and some were of unusually large proportions; megalania, for example, are extinct "guana," from eighteen to twenty feet in length. Alligators and turtles of forms now extinct infested the waters, and among the fishes was the still existing ceratodus. The remains of a varied bird fauna have been preserved in the same deposits. This fauna included some ancestral forms connecting, on the one hand, the wingless birds of New Zealand with the Australian emus, and on the other hand the Australian birds with the New Zealand apteryx. The author was inclined to attribute the disappearance of so many of these forms of ancient life quite as much to senile decay as to altered climatic influences.

Waters of the Colorado Coal Field.—The water supply of the Colorado coal field of Texas, though not abundant as a whole, is represented in the report of Messrs. N. F. Drake and R. A. Thompson, of the State Geological Survey, as usually ample and sufficient for all demands and purposes. Numerous springs burst forth from the strata and many overflowing rivers and creeks traverse the breadth of the region, which afford water unsurpassed for wholesomeness and purity. When sufficient care is exercised in their location, water for drinking purposes can be obtained from wells in nearly all parts of the area, though when bored to excessive depths the water contained is, as a rule, contaminated with salt, oil, and other impurities that exist in the strata. The Colorado, Concho, and San Saba are the only rivers flowing through the district. The Colorado, having for its origin the great springs flowing out from the eastern slope of the Staked Plains, and being re-enforced at every point of its course, furnishes an unsurpassed supply of water to its riparian inhabitants. Except in times of what is called the "red rises," its water is pure and clear. These red rises are caused by heavy rainfalls in the region of the Red Beds of the Permian and Triassic in which the Colorado heads. The beds consist of conglomerates, fine-grained sandstones, and impervious arenaceous and highly calcareous red clays and shales, which disintegrate rapidly under the action of rainfall, and the disintegrated material is borne down by the rapid current of the river. Owing to the fine-grained and impervious nature, especially of the clays, they do not silt rapidly, and the material is held in suspension by the water long after it has passed the limits of the Red Beds. The Colorado flows over numerous little falls and rapids while pursuing its course across the heavy beds of limestone and sandstone which extend from the western boundary of the Permian to the southern limit of the Upper Cretaceous. This shifting turns its every particle again and again to the purifying action of the atmosphere, and the immense beds of stiff and tenacious clays and shales do not impair its clearness. The water flowing over the limestone becomes highly charged with carbonic dioxide in solution, which oxidizes much of the organic matter that may contaminate it, and thus renders it purer. The water of the Concho River is of the same character as that of the Colorado. The San Saba runs about forty miles through the carboniferous formation. Few of the creeks or smaller streams are ever-running, but the majority of them flow except in the driest seasons. Water is obtained in them from numerous large, deep holes, the majority of which remain filled through the year, and in which it does not become stagnant.

St. Gregory of Nyssa and the Nebular Hypothesis.—In a study, in the American Ecclesiastical Review, of the exegeses by the early Christian writers, especially those of Alexandria and Cæsarea, the Rev. John A. Zahm, of the University of Notre Dame, sets forth that they were the first to propose or develop a true theory of the origin of the world, and to lay the foundations of cosmoganic doctrines that are usually credited to

investigators of a much later epoch. Thus, in the Hexæmeron of St. Gregory of Nyssa, "is developed, in unequivocal terms, the same hypothesis that has so long been regarded as the special glory of the Système du Monde of Laplace." According to this saint, the words, "In the beginning God created the heaven and the earth," "do not refer to the creation of the heavens and the earth, as we now behold them, and still less do they signify the creation of the creatures—plants, animals, and man—that inhabit the earth. They refer rather to the creation from nothing of the primitive, cosmic matter—from which all forms of matter, organic and inorganic, were subsequently fashioned. The saint finds a warrant for this interpretation in the words of Genesis itself. For, according to the inspired writer, the earth, after the first creative act, was 'void and empty,' or, as the Septuagint has it, 'invisible and discomposed.' In the beginning, then, all things were created potentially rather than in act. They were contained naturally or in germ in the invisible and unformed matter that came forth from nothing in response to the divine *fiat*. The first sentence of Genesis tells us of creation, properly so called, the *opus creationis* (or work of creation). That which follows refers to the formation from pre-existing matter of all the bodies of the universe. This is what theologians call the *opus formationis* (work of formation), and what modern scientists term the development of evolution. In the beginning, therefore, according to St. Gregory of Nyssa, all was in a chaotic or nebulous state. But it did not remain so, because the Almighty put it under the action of certain physical laws by virtue of which it was to go through that long cycle of changes of which science speaks. . . . The manner in which the saint expresses himself when treating of this subject is, considering the scientific knowledge of his time, simply marvelous. He seems to have had an intuitive knowledge of what could then not be demonstrated, and of what could be known only after the revelations of modern geography and astronomy. . . . After the primitive, nebulous matter of the cosmos was created, certain molecules, St. Gregory teaches, began, under the influence of attraction, to unite with other molecules, and to form separate masses of matter. In the course of time, these masses of matter, rotating on their axes, gave off similar masses, which assumed a spherical form. In this wise were produced the sun and moon, stars and planets. . . . In this brilliant conception, in which he could but divine what Laplace and his compeers have rendered all but certain, St. Gregory recognized the existence of laws which he was unable to detect, much less to comprehend. These were the laws made known long ages afterward by the investigations of Kepler, Newton, and Plateau, and the laws of chemical affinity which have thrown such a flood of light on the secret operations of Nature. . . . No exegetist has ever been more happy in the employment of the scientific method; no one has ever had a keener appreciation of the reign of law and order which obtains in the universe. No one has ever realized more thoroughly that the cosmos as we now see it, far from being the work of chance, is the result of a series of divine interventions, is the outcome of a gradual evolution of that primordial matter which God created in the beginning; which he then put under what we call laws of Nature; and which he still conserves by his providence."

A Monument to Lavoisier.—A proposition was published by Gustavus Hinrichs, of St. Louis, on the 8th of May of this year—it being the centenary of the death of that chemist—for the erection by the chemists of the world of a monument to the memory of Lavoisier, "the Copernicus of chemistry." "It is now well understood," Mr. Hinrichs says, "that the claims of Lavoisier to universal recognition depend in no way upon the title to the discovery of any new substance, however important. Both England and Sweden have appropriately honored their discoverers of dephlogisticated air by imposing monuments. The well-known fact that both these eminent chemists remained faithful and aggressive phlogistonists till death is an all-sufficient proof that their discovery is in no way essential to the glory of Lavoisier. The life work of Lavoisier was deeper and broader than the discovery of any new substance, and affected the very foundation of the science of chemistry. He broke through the veil of mere

phenomena, and discovered beyond it the reality of chemical processes." Some of the contemporaries of Lavoisier may have been more skilled experimenters in some directions, and no doubt he left much for his followers to do. "Nevertheless, his *Traité Élémentaire de Chimie* is unquestionably the first rational exposition of the science of chemistry, entirely resting on experimental evidence, largely his own, and admitting to the entities of matter nothing that was not actually produced; and since that day chemistry is the science of the real elements."

NOTES.

In the present course of thought and life Prof. George E. Howard sees a crisis which is determining the character of the modern university. Thus there is a growing tendency to abandon the traditional assumption that there is an essential difference in the scholastic value of studies. A new test of scholastic fitness has arisen—the test of life. All things are in process of development; whole departments of knowledge, hitherto unheard of in the schools, have received recognition. Old subjects which were thought dead have turned out to be but sleeping. Thus philosophy and the classics, subjected to the comparative method, are being made more productive than ever before for social good.

A report on the climatology of the city of Mexico, based upon hourly observations continued through sixteen years (1877 to 1892), is published by Señor Barcena, of the meteorological observatory there. The mean annual temperature is 15·4° C. The mean monthly temperature ranges from 12° C. in December to 18·1° C. in May. The highest temperatures in the shade range from 23° C. in December to 31·6° C. in April; while the limit of lowest temperature runs from −2·2° C. in December to 8·2° C. in August and September. The most rainy months are those from June to September.

A "Bird day" has been established in some of the schools of Oil City, Pa., the object of which is to promote "preservation of American birds from the women who wear them and from the small boy." The literary exercises are similar to those customary on Arbor day.

Frogs are credited by Dr. Romanes, in his Animal Intelligence, with having definite ideas of locality. A Japanese correspondent of Nature says that the same fact has been noticed of old by the Japanese and Chinese. Rejoan Terashima, in his illustrated Cyclopædia of the Three Systems of Japan and China (completed in 1713), says that "when frogs are removed far, they always long after the original locality; hence the Chinese name Hia nia." For similar reasons the Japanese call them "Kaeru," meaning *return*. This author is confirmed by the lexicographer Shisei Tagawa.

Experiments made upon certain freshwater crustaceans, says the International Journal of Microscopy, show that they are sensitive to sounds corresponding to more than forty thousand vibrations per second (sounds that we can not hear), and to ultraviolet rays that we can not perceive. Now, all the rays that we can perceive appear to us with definite colors, and it should be the same with these animals; so that it is probable that they see colors that are unknown to us, and that are as different from those that we are familiar with as red is different from yellow or green from violet. It follows from this that natural light, which seems white to us, would appear colored to them, and that the aspect of Nature would be entirely different to them from what it is to us. It is possible, therefore, that to certain animals Nature is full of sounds, colors, and sensations that we have no idea of.

An English committee of sportsmen and naturalists is taking in hand the protection of South African mammals—the giraffe, zebra, eland, gnu, koodoo, and other antelopes—against their threatened extinction. A suggested method of accomplishing this is to secure an inclosed park of about a hundred thousand acres.

In a new process for coloring leather by electrical action, the hide is stretched upon a metallic table and covered, except at the edges, with the coloring liquid. A difference of potential is established between the liquid and the metallic table. The effect of the electric current is to cause the pores of the skin to open, whereby the coloring is enabled to penetrate deeply into its tissue.

A bust of Charles Waterton, the naturalist and South American traveler, executed by the late W. Hawkins in 1865—the year in which Waterton died—has been presented to the Linnæan Society of London by the trustees of the late Mrs. Pitt Byrne. The only accessible portrait of Waterton is from an original oil painting made by C. W. Peale in Philadelphia in 1824. An engraving of it forms the frontispiece of the third volume of the Essays on Natural History. The bust and the portrait correspond well when allowance is made for the forty years' difference in the age of the subject.

Dr. Franz Stuhlman, who accompanied Emin Pasha into the heart of Africa, saw much of the people called Pygmies. He looks upon them as the remnant of a primeval race which at one time occupied the

whole of tropical Africa and southern Asia. They have lost their original language, and have been encroached upon by surrounding tribes, even within the dense forests to which they retired, until they are met with only in scattered remnants. No trace of degeneracy is to be found among them, for, according to the accounts, they are well proportioned "and certainly not rachitic."

EVIDENCE is adduced in Nature, by J. Howard Mummery, contradictory of the hypothesis that caries of the teeth is a modern disease and confined to civilized races. The author's father, in a communication to the Odontological Society in 1870, brought together the results of an inquiry extending over more than ten years, in which he examined more than two thousand skulls, and was brought to very different conclusions. Among thirty-six Egyptian skulls, caries was found in fifteen (41·66 per cent); among seventy-six Anglo-Saxon, twelve (15·78 per cent); among one hundred and forty-three skulls of Romano-Britons, forty-one (28·67 per cent); and among forty-four miscellaneous skulls of ancient Britons, 20·45 per cent, showed carious teeth. Of modern savage races, among the Tasmanians, 27·7 per cent, of caries was found; among native Australians, 20·45 per cent; among East African skulls, 24·24 per cent; and among the skulls of West African natives, 27·96 per cent.

BOOKS are protected in India against the attacks of insects by pouring a few teaspoonfuls of refined mineral naphtha, or benzine collas, into the crevices of the binding, and then shutting up the volume in a close-fitting box. They have to be afterward sprayed over lightly with the finest kerosene oil, which should be rubbed off before it penetrates the binding. Another way is to brush the books over with a saturated solution of corrosive sublimate. In the Indian Museum Library the books are kept in close-fitting glass cases with a few ounces of naphthaline upon each shelf. The paste used in binding these books is also poisoned with sulphate of copper.

IN the Kelvingrove Museum, Glasgow, is a crow's nest from Rangoon made of iron wire, such as is used in fastening the corks of aërated water bottles. Mr. Campbell, of the museum, quotes from the donor of the curiosity, who says that such nests can always be obtained from high trees in the vicinity of the factories of aërated water.

AN extensive series of minute chipped stone implements from India, which has lately come into the possession of the United States National Museum, is described by Curator Thomas Wilson as comprising every condition of the implement and having the single peculiarity, in which these differ from other prehistoric implements, of remarkably small size. The cores are rarely more than an inch and three quarters in length, and the blades are rarely more than an inch and a quarter or an inch and a half, the majority of them being not more than an inch, while the finished specimen is frequently not more than five eighths of an inch in length. The finished implements are of various forms—slim, almost needlelike, triangular, with a base convex, straight, or concave, quadrilateral, trapezoid, rhomboidal, while the most delicate and finely finished are in the form of a crescent.

IN their woodcut engraving, according to Mr. T. Tokuno, of the United States National Museum, the Japanese artists strive to imitate the original, even to the sweep of the brush, so closely that it shall be difficult for an inexperienced person to detect the difference, and they have been wonderfully successful. The methods employed by them are those used in Europe in the fifteenth, sixteenth, and seventeenth centuries. The material is wood cut in the direction of the fiber, or planks, for which since Bewick's time blocks cut across the fiber have been substituted with us.

THE chief features of the Karst (limestone) regions of eastern Europe, according to Dr. Jovan Cirjic, are those known as *karren dolinen*, blind valleys, and *poljen*. The *karren* are surfaces composed of blocks of limestone separated by narrow fissures. The *dolinen*, called by English writers swallow holes, sink holes, or cockpits, are rounded hollows varying from thirty to more than three thousand feet in diameter and from six feet to three hundred and thirty feet in depth, and great numbers of them often occur in a limited space. They may be dish, funnel, or well shaped, or of other forms. Besides the simple basins, the *dolinen* also occur in the form of chimneys communicating below with blind cavities or with underground river courses or systems of fissures. The first are known in France as *avens*, and the second in Jamaica as *light holes*.

IN the Mining School at Houghton, which had one hundred and one pupils in 1893, Michigan claims to possess the largest school of mining engineering in the United States. The school also excels in the number of graduates in proportion to its age. Its pupils are mostly farmers' sons, and twenty-three States and foreign countries are represented among them. Its equipment has been planned with the idea of providing the means for each student to occupy his entire time without obliging him to wait, and of making the laboratory take the place, to a large extent, of instructors. Candidates for admission are expected to be proficient in the use of the English language and in the special subjects required, including the solution of practical problems in mathematics. A three years' course is prescribed.

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